

# Who wrote What Where: Analyzing the content of human and automatic summaries

**Karolina Owczarzak and Hoa Trang Dang**

Information Access Division

National Institute of Standards and Technology

Gaithersburg, MD 20899

karolina.owczarzak@nist.gov hoa.dang@nist.gov

## Abstract

Abstractive summarization has been a long-standing and long-term goal in automatic summarization, because systems that can generate abstracts demonstrate a deeper understanding of language and the meaning of documents than systems that merely extract sentences from those documents. Genest (2009) showed that summaries from the top automatic summarizers are judged as comparable to manual extractive summaries, and both are judged to be far less responsive than manual abstracts. As the state of the art approaches the limits of extractive summarization, it becomes even more pressing to advance abstractive summarization. However, abstractive summarization has been sidetracked by questions of what qualifies as important information, and how do we find it? The Guided Summarization task introduced at the Text Analysis Conference 2010 attempts to neutralize both of these problems by introducing topic categories and lists of aspects that a responsive summary should address. This design results in more similar human models, giving the automatic summarizers a more focused target to pursue, and also provides detailed diagnostics of summary content, which can help build better meaning-oriented summarization systems.

## 1 Introduction

What qualifies as important information and how do we find it? These questions have been leading research in automatic summarization since its beginnings, and we are still nowhere near a definitive answer. Worse, experiments with human subjects

suggest a definitive answer might not even exist. With all their near-perfect language understanding and world knowledge, two human summarizers will still produce two different summaries of the same text, simply because they will disagree on what's important. Fortunately, usually some of this information will overlap. This is represented by the idea behind the Pyramid evaluation framework (Nenkova and Passonneau, 2004; Passonneau et al., 2005), where different levels of the pyramid represent the proportion of concepts ("Summary Content Units", or SCUs) mentioned by 1 to  $n$  summarizers in summaries of the same text. Usually, there are very few SCUs that are mentioned by all summarizers, a few more that are mentioned by some of them, and the greatest proportion are the SCUs that are mentioned by individual summarizers only.

This variance in what should be a "gold standard" makes research in automatic summarization methods particularly difficult. How can we reach a goal so vague and under-defined? Using term frequency to determine important concepts in a text has proven to be very successful, largely because of its simplicity and universal applicability, but statistical methods can only provide the most basic level of performance. On the other hand, there is no real motivation to use any deeper meaning-oriented text analysis if we are not even certain what information to look for in order to produce a responsive summary.

To address these concerns, the Summarization track at the 2010 Text Analysis Conference<sup>1</sup> (TAC) introduced a new summarization task – Guided Summarization – in which topics are divided into

<sup>1</sup>All datasets available at <http://www.nist.gov/tac/>

narrow categories and a list of required aspects is provided for each category. This serves two purposes: first, it creates a more focused target for automatic summarizers, neutralizing human variance and pointing to concrete types of information the reader requires, and second, it provides a detailed diagnostic tool to analyze the content of automatic summaries, which can help build more meaning-oriented systems. This paper shows how these objectives were achieved in TAC 2010, looking at the similarity of human-crafted models, and then using the category and aspect information to look in depth at the differences between human and top automatic summarizers, discovering strengths and weaknesses of automatic systems and areas for improvement.

## 2 Topic-specific summarization

The idea that different types of stories might require different approaches is not new, although the classification varies from task to task. Topic categories were present in Document Understanding Conference<sup>2</sup> (DUC) 2001, where topics were divided into: single-event, single-subject, biographical, multiple events of same type, and opinion. In their analysis of these results, Nenkova and Louis (2008) find that summaries of articles in what they call *topic-cohesive* categories (single-event, single-subject, biography) are of higher quality than those in *non-cohesive* categories (opinion, multiple event).

In essence, categorizing topics into types is based on the assumption that stories of the same type follow a specific template and include the same kinds of facts, and this predictability might be employed to improve the summarization process, since we at least know *what kinds of information* are important and what to look for. This was shown, among others, by Bagga (1997), who analyzed source articles used in the Message Understanding Conference (MUC) and graphed the distribution of facts in articles on air vehicle launches, terrorist attacks, joint ventures, and corporate personnel changes, finding that the same kinds of facts appeared repeatedly. A natural conclusion is that Information Extraction (IE) methods might be helpful here, and in fact, White et al. (2001) presented an IE-based summarization system for natural disasters, where they first filled

<sup>2</sup><http://www-nlpir.nist.gov/projects/duc/>

an IE template with slots related to date, location, type of disaster, damage (people, physical effects), etc. Similarly, Radev and McKeown (1998) used IE combined with Natural Language Generation (NLG) in their SUMMON system.

There are two ways to classify stories: according to their level of cohesiveness (to use the distinction made by Nenkova and Louis (2008)), and according to subject. The first classification could help us determine which topics would be easier for automatic summarization, but the difficulty is related purely to lexical characteristics of the text; as shown in Louis and Nenkova (2009), source document similarity in terms of word overlap is one of the predictive features of multi-document summary quality. The second classification, according to subject matter, is what enables us to utilize more meaning-oriented approaches such as IE and attempt a deeper semantic analysis of the source text, and is what we describe in this paper.

## 3 Guided summarization at TAC

The new guided summarization task in 2010 was designed with the second classification in mind, in order to afford the participants a chance to explore deeper linguistic methods of text analysis. There were five topic categories: (1) Accidents and Natural Disasters, (2) Attacks (Criminal/Terrorist), (3) Health and Safety, (4) Endangered Resources, and (5) Trials and Investigations (Criminal/Legal/Other).<sup>3</sup> In contrast to previous topic-specific summarization tasks, the Guided Summarization task also provided a list of required aspects, which described the type of information that should be included in the summary (if such information could be found in source documents). Summarizers also had the option of including any other information they deemed important to the topic. The categories and their aspects, shown in Table 1, were developed on the basis of past DUC and TAC topics and model summaries from years 2001-2009.

Each topic came with 20 chronologically ordered

<sup>3</sup>In the remainder of this paper, the following short forms are used for names of categories: Accidents = Accidents and Natural Disasters; Attacks = Attacks; Health = Health and Safety; Resources = Endangered Resources; Trials = Trials and Investigations. Full description of the task is available at the TAC website.

Accidents	Attacks	Health
what	what	what
when	when	who affected
where	where	how
why	perpertrators	why
who affected	why	countermeasures
damages	who affected	
countermeasures	damages	
	countermeasures	

Resources	Trials
what	who
importance	who investigating
threats	why
countermeasures	charges
	plead
	sentence

Table 1: Categories and aspects in TAC 2010 Guided Summarization task.

news articles. The *initial* summaries were to be produced on the basis of the first 10 documents. As in TAC 2008 and 2009, the 2010 Summarization task had an update component: using the second 10 documents, summarizers were to produce an *update* summary under the assumption that the user had already read the first set of source documents. This means that for the update part, there were two interacting conditions, with the requirement for non-redundancy taking priority over the requirement to address all category aspects.

For each topic, four model summaries were written by human assessors. All summaries were evaluated with respect to linguistic quality (Overall Readability), content (Pyramid), and general quality (Overall Responsiveness). Readability and Responsiveness were judged by human assessors on a scale from 1 (very poor) to 5 (very good), while Pyramid is a score between 0 and 1 (in very rare cases, it exceeds 1, if the candidate summary contains more SCUs than the *average* reference summary).

Since this was the first year of Guided Summarization, only about half of the 43 participating systems made some use of the provided categories and aspects, mostly using them and their synonyms as query terms.

### 3.1 Model summaries across years

The introduction of categories, which implies template story types, and aspects, which further narrows content selection, resulted in the parallel model summaries being much more similar to each other than in previous years, as represented by the Pyra-

		human		automatic	
		initial	update	initial	update
Respons. Pyramid	2008	0.66	0.63	0.26	0.20
	2009	0.68	0.60	0.26	0.20
	2010	0.78	0.67	0.30	0.20
	2008	4.62	4.62	2.32	2.02
	2009	4.66	4.48	2.32	2.17
	2010	4.76	4.71	2.56	2.10

Table 2: Macro-average Pyramid and Responsiveness scores for initial and update summaries for years 2008-2010. Responsiveness scores for 2009 were scaled from a ten-point to a five-point scale.

mid score, which measures information overlap between a candidate summary and a set of reference summaries. Table 2 shows the macro-averaged Pyramid and Responsiveness scores for years 2008-2010. Both initial and update human summaries score higher for Pyramid in 2010, and also gain a little in Responsiveness. The macro-averages for automatic summarizers, on the other hand, increase only for initial summaries, which we will discuss further in Section 3.4. The similarity effect among model summaries can be more clearly seen in Table 3, which shows the percentage of Summary Content Units (SCUs, information “nuggets” or simple facts) with different weights in Pyramids across the years between 2008-2010. The weight of an SCU is simply the number of model summaries in which this information unit appears. Pyramids in 2010 have greater percentage of SCUs with weight  $> 1$ , and their proportion of weight-1 SCUs is below half of all SCUs. The difference is much more pronounced for the initial summaries, since the update component is restricted by the non-redundancy requirement, resulting in more variance in content selection after the required aspects have been covered.<sup>4</sup>

### 3.2 Content coverage in TAC 2010

During the Pyramid creation process, assessors extracting SCUs from model summaries were asked to mark the aspect(s) relevant to each SCU. This lets us examine and compare the distribution of information in human and automatic summaries. Table 4 shows macro-average SCU counts in Pyramids com-

<sup>4</sup>Each summary could be up to 100 words long, and no incentive was given for writing summaries of shorter length; therefore, the goal for both human and automatic summarizers was to fit as much relevant information as possible in the 100-word limit.

	SCU weight	2008	2009	2010
initial	4	9%	12%	22%
	3	14%	13%	18%
	2	22%	23%	24%
	1	55%	52%	36%
update	4	8%	7%	11%
	3	12%	12%	14%
	2	21%	20%	26%
	1	59%	62%	49%

Table 3: Percentage of SCUs with weights 1–4 in pyramids for initial and update summaries for years 2008–2010.

posed of four human summaries, and macro-average counts of matching SCUs in the summaries of the 15 top-performing automatic summarizers (as determined by their Responsiveness rank on initial summaries).<sup>5</sup> Although automatic summaries find only a small percentage of all available information (as represented by the number of Pyramid SCUs), the SCUs they find for the initial summaries are usually those of the highest weight, i.e. encoding information that is the most essential to the topic.

SCU distribution in human summaries is also interesting: Health, Resources, and Trials all have the expected pyramid shape, with many low-weight SCUs at the base and few high-weight SCUs on top, but for Attacks and Accidents, the usual pattern is broken and we see an hourglass shape instead, reflecting the presence of many weight-4 SCUs. The most likely explanation is that these two categories are guided by a relatively long list of aspects (cf. Table 1), many of which have unique answers in the source text.

This is shown in more detail in Table 5, which presents aspect coverage by Pyramids and top 15 automatic summarizers in terms of an average number of SCUs relevant to a given aspect and an average weight of an aspect-related SCU. Only Attack and Accidents have aspects that tend to generate the same answers from almost all human summarizers: *when, where* in Accidents and *what, when, where, perpetrators*, and *who\_affected* in Attacks all have average weight of around 3. The patterns hold for update summaries; although all values decrease and

<sup>5</sup>We chose to use the top 15 out of 43 participating systems in order to exclude outliers like systems that returned empty summaries, and to measure the state-of-the-art in the summarization field.

	SCU weight	initial		update	
		pyramids	automatic	pyramids	automatic
Accidents	4	6.4	3.2	1.9	0.5
	3	3.7	1	3.43	0.8
	2	6.9	1.6	6.1	0.6
	1	7.9	0.8	7.6	0.7
	total	24.9	7.7	19.1	3.1
Attacks	4	7.7	4.9	3.7	1
	3	3.1	0.8	3.7	0.8
	2	5	1	5.3	0.8
	1	5.6	0.5	9.4	0.7
	total	21.4	9.1	22.1	3.9
Health	4	4.9	1.8	1.6	0.4
	3	4.2	0.8	2.6	0.7
	2	5.3	0.6	4.9	0.8
	1	10.6	0.9	12	0.8
	total	25	5	21	3
Resources	4	4.2	1.5	1.1	0.6
	3	5.1	1.3	2.7	0.5
	2	5	1	5.9	1
	1	9.5	0.7	12.4	1
	total	23.8	5	22.1	3.4
Trials	4	4.4	2.6	3.4	1.2
	3	5.7	2	3.3	0.5
	2	7.8	1.6	5.7	0.6
	1	9.2	0.5	8.5	0.6
	total	27.1	8.5	20.9	3.3

Table 4: Macro-average SCU counts with weights 1–4 in pyramids and matching SCU counts in automatic summaries, for initial and update summaries.

there is less overlap between models, answers to these aspects are the most likely to occur in multiple summaries.

The situation for top 15 automatic summarizers is even more interesting: while they contain relatively few matching SCUs, the SCUs they do find are those of high weight, as can be seen by comparing their SCU weight averages. Even for “other”, which covers “all other information important for the topic” and is therefore more dependent on summary writer’s subjective judgment and shows more content diversity, resulting in low-weight SCUs in the Pyramid, the top automatic summarizers find those most weighted. It would seem, then, that the content selection methods are able to identify some of the most important facts; at the same time, the density of information in automatic summaries is much lower than in human summaries, indicating that the automatic content is either not compressed adequately, or that it includes non-relevant or repeated information.

	Avg SCU weight (avg SCU count)				
	initial summaries		update summaries		
	Pyramids	automatic	Pyramids	automatic	
Accidents	what	2.4 (4.4)	3.1 (1.9)	2.5 (2.7)	2.87 (0.6)
	when	3.6 (2.1)	3.7 (0.7)	3.7 (0.4)	4 (0.1)
	where	3.0 (3.6)	3.2 (1.3)	2.1 (1.1)	2.58 (0.4)
	why	2.6 (2.3)	3.1 (0.5)	2.4 (2.0)	3 (0.3)
	who.aff	2.3 (4.9)	2.8 (1.5)	2.0 (4.1)	2.45 (0.6)
	damages	1.8 (2.4)	3.1 (0.5)	1.7 (1.9)	2.05 (0.2)
	counterterm	2.1 (8.0)	2.7 (1.2)	2.0 (8.1)	2.4 (0.9)
	other	1.3 (0.4)	1.9 (0.1)	1.3 (0.6)	1 (0.0)
Attacks	what	2.9 (3.1)	3.7 (1.6)	2.0 (1.4)	2.8 (0.4)
	when	3.4 (1.3)	3.8 (0.4)	2.4 (1.4)	2.2 (0.1)
	where	2.7 (2.9)	3.7 (1.2)	2.5 (0.9)	3.8 (0.3)
	perpetr	2.8 (3.6)	3.4 (1.0)	2.2 (3.0)	3.0 (0.9)
	why	2.1 (3.4)	2.8 (0.9)	1.8 (1.3)	1.6 (0.2)
	who.aff	3.3 (4.0)	3.6 (1.7)	2.0 (2.0)	2.1 (0.3)
	damages	2.2 (0.9)	3.0 (0.2)	3.4 (0.7)	4.0 (0.1)
	counterterm	2.3 (4.3)	2.8 (1.1)	2.1 (10.3)	2.6 (1.1)
other	1.7 (1.3)	2.2 (0.1)	1.6 (2.6)	1.7 (0.2)	
Health	what	2.4 (6.0)	3.1 (1.6)	2.4 (2.9)	3.0 (0.7)
	who.aff	2.0 (5.6)	2.6 (0.8)	1.8 (2.7)	2.0 (0.3)
	how	2.4 (6.6)	3.1 (1.1)	1.6 (2.7)	2.4 (0.3)
	why	2.2 (3.9)	2.9 (0.6)	1.7 (2.3)	2.1 (0.4)
	counterterm	2.0 (6.3)	2.7 (0.8)	1.7 (10.4)	2.2 (1.0)
	other	1.1 (0.6)	1.9 (0.1)	1.2 (1.9)	1.6 (0.2)
Resources	what	2.3 (3.2)	2.9 (1.3)	1.6 (1.4)	2.6 (0.4)
	important	2.4 (3.1)	2.7 (0.3)	1.8 (1.9)	2.3 (0.2)
	threats	2.3 (7.6)	2.8 (1.6)	1.6 (6.8)	2.0 (1.1)
	counterterm	2.0 (10.1)	2.8 (1.7)	1.7 (12.1)	2.2 (1.4)
	other	1.4 (0.7)	2.9 (0.1)	1.8 (1.2)	2.5 (0.1)
	who	2.7 (3.5)	3.2 (1.7)	2.7 (2.3)	3.2 (0.4)
Trials	who.inv	1.9 (5.5)	2.8 (0.8)	1.8 (3.3)	2.6 (0.5)
	why	2.6 (6.3)	3.1 (2.2)	1.8 (2.4)	2.3 (0.3)
	charges	2.7 (2.4)	3.2 (0.8)	2.4 (1.4)	2.5 (0.3)
	plead	2.0 (5.0)	2.9 (0.9)	2.1 (3.5)	3.0 (0.5)
	sentence	2.3 (2.7)	3.0 (0.5)	2.6 (6.0)	3.5 (0.8)
	other	1.5 (3.2)	2.0 (0.3)	1.7 (4.8)	2.4 (0.6)

Table 5: Aspect coverage for Pyramids and top 15 automatic summarizers in TAC 2010.

### 3.3 Effect of categories and aspects

Some categories in the Guided Summarization task are defined in more detail than others, depending on types of stories they represent. Stories about attacks and accidents (and, to some extent, trials) tend to follow more predictable and detailed templates, which results in more similar models and better results for automatic summarizers. Figure 1 gives a graphic representation of the macro-average Pyramid and Responsiveness scores for human and top 15 automatic summarizers, with exact scores in Tables 6 and 7, where the first score marked with a letter is not statistically significant from any subsequent score marked with the same letter, according to ANOVA ( $p > 0.05$ ). Lack of significant difference between human Responsiveness scores in Table 6 suggests that, for all categories, human summaries

are highly and equally responsive, but a look at their Pyramid scores confirms that Attacks and Accidents models tend to have more overlapping information.

For automatic summaries, their Pyramid and Responsiveness patterns are parallel. Here Attacks, Accidents, and Trials contain on average more matching SCUs than Health and Resources, making these summaries more responsive. One reason for these differences might be that many systems rely on sentence position in the extraction process, and first sentences in these template stories often are a short description of event including date, location, persons involved, in effect giving systems the unique-answer aspects mentioned in Section 3.2. Table 5 shows this distribution of matching information in more detail: for Attacks and Accidents, automatic summarizers match relatively more SCUs for *what*, *where*, *when*, *who\_affected* than for *countermeasures*, *damages*, or *other*. For Trials, again the easier aspects are those that tend to appear at the beginning of documents: *who* [is under investigation] and *why*. Stories in Health and Resources, the weakest categories overall for automatic summarizers and with the greatest amount of variance for human summarizers, are non-events, instead being closer to what in past DUC tasks was described as a “multi-event” or “single subject” story type. Individual documents within the source set might sometimes follow the typical event template (e.g. describing individual instances of coral reef destruction), but in general these categories require much more abstraction and render the opening-sentence extraction strategy less effective.

If the higher averages are really due to the information extracted with first sentences, then we would also expect higher scores from Baseline 1, which simply selected the opening sentences of the most recent document, up to the 100-word limit. And indeed, as shown in Table 8, the partial Pyramid scores for Baseline 1 are the highest for exactly these “concrete” categories and aspects, mostly for Attacks and Accidents, and aspects such as *where*, *what*, and *who* (the score of 1 for Accidents *other* is an outlier, since there was only one SCU relevant for this calculation and the baseline happened to match it). On the other hand, its lowest performance is mostly concentrated in Health and Resources, and in the more “vague” aspects, like *why*, *how*, *importance*, *coun-*

	Pyramid		Responsiveness	
initial	Attacks	0.857 A	Trials	4.825 A
	Accidents	0.812 AB	Accidents	4.821 AB
	Resources	0.773 AB	Attacks	4.786 ABC
	Health	0.767 AB	Health	4.750 ABCD
	Trials	0.751 B	Resources	4.650 ABCD
update	Trials	0.749 A	Attack	4.857 A
	Attacks	0.745 AB	Trials	4.825 AB
	Accidents	0.700 AB	Accidents	4.714 ABC
	Health	0.610 C	Health	4.625 ABCD
	Resources	0.604 C	Resources	4.600 ABCD

Table 6: Macro-average Pyramid and Responsiveness scores per category for human summaries, comparison across categories.

	Pyramid		Responsiveness	
initial	Attacks	0.524 A	Attacks	3.400 A
	Trials	0.446 B	Accidents	3.362 AB
	Accidents	0.418 B	Trials	3.167 ABC
	Resources	0.323 C	Resources	2.893 CD
	Health	0.290 C	Health	2.617 D
update	Resources	0.286 A	Resources	2.520 A
	Trials	0.261 AB	Health	2.417 AB
	Attacks	0.251 ABC	Trials	2.380 ABC
	Health	0.236 BCD	Attacks	2.286 ABCD
	Accidents	0.228 BCD	Accidents	2.248 ABCD

Table 7: Macro-average Pyramid and Responsiveness scores per category for top 15 automatic summaries, comparison across categories.

*termeasures*, and *other*. We can conclude that early sentence position is not a good predictor of such information, and that automatic summarizers might do well to diversify their methods of content identification based on what type of information they are looking for.

### 3.4 Initial and update summaries

While the initial component is only guided by the categories and aspects, the update component is placed under an overarching condition of non-redundancy. Update summaries should not repeat

Highest			Lowest		
Category	Aspect	score	Category	Aspect	score
(Accidents)	Other	1)	Resources	other	0
Attacks	WHERE	0.66	Health	other	0
Attacks	WHAT	0.66	Attacks	COUNTERM	0
Trials	WHO	0.6	Attacks	other	0
Attacks	WHO_AFF	0.56	Accidents	WHY	0
Accidents	WHERE	0.44	Health	WHO_AFF	0
Accidents	WHAT	0.41	Trials	SENTENCE	0.06
Trials	WHY	0.38	Health	WHY	0.06
Attacks	PERP	0.34	Accidents	DAMAGES	0.07
Trials	WHO_INV	0.33	Health	HOW	0.08
Trials	CHARGES	0.33	Resources	IMPORANT	0.09

Table 8: Top Pyramid scores for Baseline 1, per aspect, for initial summaries.

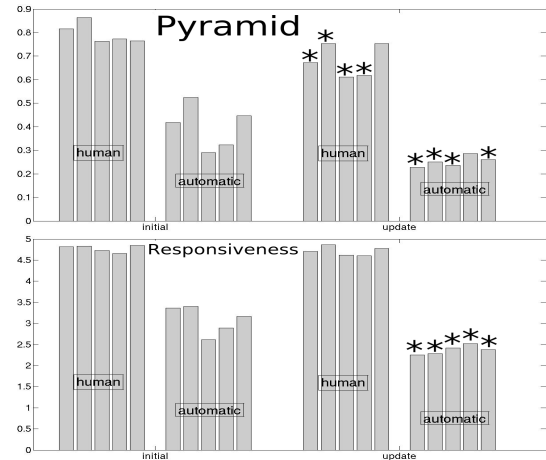


Figure 1: Macro-average Pyramid and Responsiveness scores in initial and update summaries, for humans and top 15 automatic systems. In each group, columns from left: Accidents, Attacks, Health, Resources, Trials. Asterisk indicates significant drop from initial score.

any information that can be found in the initial document set. This restriction narrows the pool of potential summary elements to choose from. More importantly, since the concrete aspects with unique answers like *what*, *where*, and *when* are likely to be mentioned in the first set of document (and, by extension, in the initial summaries), this shifts content selection to aspects that generate more variance, like *why*, *countermeasures*, or *other*. As shown in Figure 1, while Responsiveness remains high for human summarizers across categories, which means the content is still relevant to the topic, the Pyramid scores are lower in the update component, which means the summarizers differ more in terms of what information they extract from the source documents. Note that this is not the case for Trials, where the human performance for both Responsiveness and Pyramid is practically identical for initial and update summaries. The time course of trials is generally longer than those for accidents and attacks, and many of the later-occurring aspects such as plea and sentence are well-defined; hence the initial and update human summaries have similar Pyramid scores. Automatic summarizers, on the other hand, suffer the greatest drop in those categories in which they were the most successful before: Attacks, Accidents, and Trials, in effect rendering their performance across categories more or less even (cf. Fig-

ure 1).

A closer look at the aspect coverage in initial and update components confirms the differences in aspect distribution. Figure 2 gives four columns for each aspect: the first two columns represent initial summaries, the second two represent update summaries. Dark columns in each pair are human summarizers, light columns are top 15 automatic summarizers. For almost all aspects, humans find fewer relevant (and new!) facts in the update documents, with the exception of *sentence* in Trials, and *countermeasures* and *other* in all categories. Logically, once all the anchoring information has been given (date, time, location, event), the only remaining relevant content to focus on are consequences of the event (*countermeasures*, *sentence*), and possibly updates in victims and damages (*who\_affected*, *damages*) as well as any *other* information that might be relevant. A similar (though less consistent) pattern holds for automatic summarizers.

#### 4 Summary and conclusions

Initial attempts at more complex treatments of any subject often fail when faced with unrestricted, “real world” input. This is why almost all research in summarization remains centered around relatively simple extractive methods. Few developers try to incorporate syntactic parsing to compress summary sentences, and almost none want to venture into semantic decomposition of source text, since the complexity of these methods is the cause of potential errors. Also, the tools might not deal particularly well with different types of stories in the “newswire” genre. However, Genest (2009) showed the limits of purely extractive summarization: their manual, extractive summarizer (HexTac) performed much worse than human abstractors, and comparably to the top automatic summarizers in TAC 2009.

But if we want to see significant progress in abstractive summarization, it’s important to provide a more controlled environment for such experiments. TAC 2010 results show that, first of all, by guiding summary creation we end up with more similar human abstracts than in previous tasks (partly due to the choice of template-like categories, and partly due to the further guiding role of aspects). Narrowing down possible summary content, while exclud-

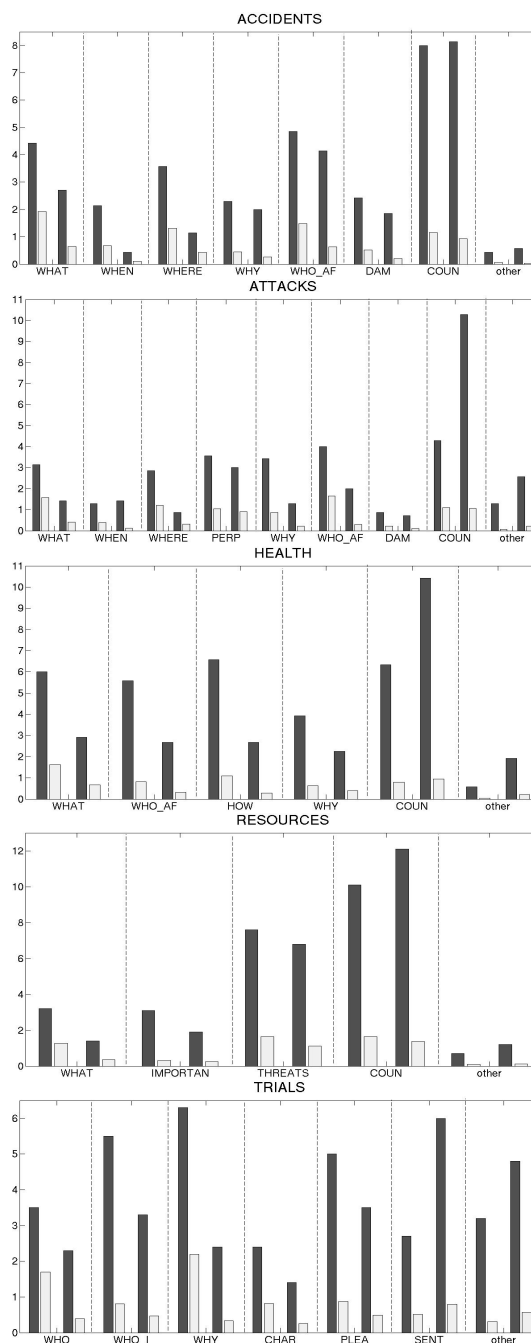


Figure 2: Average number of SCUs per aspect in initial and update summaries in TAC 2010. Dark grey = Pyramids, light grey = top 15 automatic summarizers. The first pair of columns for each aspects shows initial summaries, the second pair shows update summaries.

ing variance due to subjective opinions among human writers, creates in effect a more concrete information model, and a single, unified information model is an easier goal to emulate than relying on vague and subjective goals like “importance”. Out of five categories, Attacks and Accidents generated the most similar models, mostly because they required concrete, unique-answer aspects like *where* or *when*. In Health and Resources, the aspects were more subjective in nature, and the resulting variance was greater.

Moreover, the Guided Task provides a very valuable and detailed diagnostic tool for system developers: by looking at the system performance within each aspect, we can find out which types of information it is better able to identify. While the top automatic summarizers managed to retrieve less than half of relevant information at the best of times, the facts they did retrieve were highly-weighted. Their better performance for certain aspects of Attacks, Accidents, and Trials could be ascribed to the fact that most of them rely on sentence position to determine important information in the source document. A comparison of covered aspects suggests that sentence position might be a better indicator for some types of information than others.

Since it was the first year of the Guided Task, only some of the teams used the provided category/aspect information; as the task continues, we hope to see more participants adopting categories and aspects to guide their summarization. The predictable elements of each category invite the use of different techniques depending on the type of information sought, perhaps suggesting the use of Information Extraction methods. Some categories might be easier to process than others, but even if the information-mining approach cannot be extended to all types of stories, at worst we will end up with better summarization for event-type stories, like attacks, accidents, or trials, which together comprise a large part of reported news.

## References

Amit Bagga and Alan W. Biermann. 1997. Analyzing the Complexity of a Domain With Respect To An Information Extraction Task. *Proceedings of the tenth*

- International Conference on Research on Computational Linguistics (ROCLING X)*, 175–194.
- Pierre-Etienne Genest, Guy Lapalme, and Mehdi Yousfi-Monod. 2009. HEXTAC: the Creation of a Manual Extractive Run. *Proceedings of the Text Analysis Conference 2009*.
- Annie Louis and Ani Nenkova. 2009. Performance confidence estimation for automatic summarization. *Proceedings of the 12th Conference of the European Chapter of the Association for Computational Linguistics*, 541–548. Athens, Greece.
- Kathleen R. McKeown, Regina Barzilay, David Evans, Vasileios Hatzivassiloglou, Judith L. Klavans, Ani Nenkova, Carl Sable, Barry Schiffman, and Sergey Sigelman. 2002. Tracking and summarizing news on a daily basis with Columbia’s Newsblaster. *Proceedings of the Second International Conference on Human Language Technology Research*, 280–285. San Diego, California.
- Ani Nenkova and Annie Louis. 2008. Can You Summarize This? Identifying Correlates of Input Difficulty for Multi-Document Summarization. *Proceedings of ACL-08: HLT*, 825–833. Columbus, Ohio.
- Ani Nenkova and Rebecca J. Passonneau. 2004. Evaluating content selection in summarization: The Pyramid method. *Proceedings of the Human Language Technology Conference of the North American Chapter of the Association for Computational Linguistics*, 145–152. Boston, MA.
- Rebecca J. Passonneau, Ani Nenkova, Kathleen McKeown, and Sergey Sigelman. 2005. Applying the Pyramid method in DUC 2005. *Proceedings of the 5th Document Understanding Conference (DUC)*. Vancouver, Canada.
- Dragomir R. Radev and Kathleen R. McKeown. 1998. Generating natural language summaries from multiple on-line sources. *Computational Linguistics*, 24(3):470–500.
- Michael White, Tanya Korelsky, Claire Cardie, Vincent Ng, David Pierce, and Kiri Wagstaff. Multidocument summarization via information extraction. 2001. *Proceedings of the First International Conference on Human Language Technology Research*, 1–7. San Diego, California.