

# Textual Analysis

The starting point for our study consisted of two different kinds of analysis of 51 texts authored by 45 astronauts and cosmonauts either during their space travel (n= 17) -- available at [http://www.nasa.gov/centers/johnson/astronauts/journals\\_astronauts.html](http://www.nasa.gov/centers/johnson/astronauts/journals_astronauts.html) -- or after their return to earth (n= 34). These texts captured details of their visual and affective experiences during space flight in the Shuttle or the International Space Station (ISS). The majority of the selected texts involved descriptions of experiences undergone while looking out of the space vehicle's windows with views of earth or deep space from close earth orbit. For purposes of analysis, numbers from 1 to 51 were assigned and information about the author, including name, was not included. In other words, the text spoke for itself, irrelevant of demographics or personal identifiers. The first analysis was syntactical -- looking at aspects of structure in regard to coherence and degrees of abstractness; the second hermeneutical -- focused on contextual meaning.

## The syntactical analysis

We conducted a syntactical analysis using the Coh-Metrix computer software developed in the Psychology Department at the University of Memphis (<http://cohmetrix.memphis.edu>). Coh-Metrix analyzes the coherence of texts based on a wide range of measures (Graesser et al. 2004). We were interested in a number of questions that Coh-Metrix can answer. One of the things we wanted to know is whether there are significant differences between the in-flight journals and the post-flight descriptions found in interviews and books. Preliminary results indicate causal cohesion and differentiation of concreteness versus abstractness of the narratives.

Causal cohesion reflects the extent to which sentences relate to each other by expressed causal relations. It calculates the number of semantically identifiable causal verbs (e.g. *drop, fill*), causal particles (*because, in order to*) and semantically depleted verbs (e.g., *cause, make*). The more causal verbs in a text, the more the text is assumed to convey causal content. Cohesion drops, however, when a text contains too many causal verbs (signifying events and actions), but few causal particles that provide an indication of how the events and actions are connected. Causal cohesion is the ratio of causal particles to causal verbs (Fig. 1a).

Coh-Metrix also measures word abstractness. A word is *abstract* when it has few distinctive features and few attributes. Abstractness is measured in Coh-Metrix by the noun *hypernym* values in Word-Net, an online lexical reference system (Fellbaum, 1998; Miller, et al., 1990). The hypernym count is defined by Coh-Metrix as "the number of levels in a conceptual taxonomic hierarchy above (superordinate to) a word. For example, chair (as a seat) has 7 hypernym levels: seat → furniture → furnishings → instrumentality → artifact → object → entity. A word having more hypernym levels is more concrete. A word with fewer hypernym levels is more abstract"

(<http://cohmetrix.memphis.edu/CohMetrixWeb2/HelpFile2.htm>) (Fig. 1b).

Likewise, Coh-Metrix assesses how concrete or non-abstract a word is on the basis of human ratings using the MRC Psycholinguistics Database (Coltheart 1981). Concreteness measures the degree to which a word has easily accessible mental images and direct sensory referents. Words like “spoon” or “water” are less abstract than words like “justice” or “moral.” Higher scores are more concrete than low scores. (Fig 1c).

On all three measures, the in-flight journals have the virtue of a more immediate, perception-based reporting in that they reflect more causal coherence and are more concrete (less abstract) than post-flight reports. In addition, since a more reflective memory is involved in the post-flight texts, and more temporal distance from the original experience, post-flight texts may not be as dependable as a veridical portrayal of that experience. This may justify further analysis to see if these differences reflect differences in type or frequency of occurrence of the specific consensus categories (see below), and whether the post-simulation interviews from our experiments are closer to in-flight journals or post-flight texts in this regard.

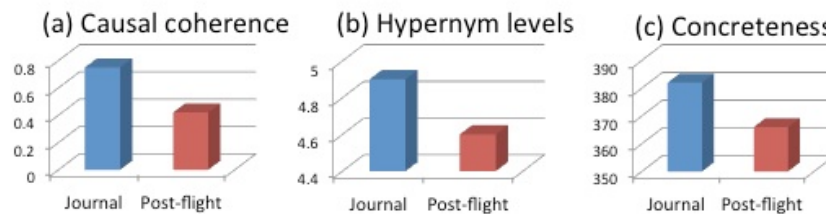


Figure 1: Coh-Metrix Analysis

### The hermeneutical analysis

Two interpreters working independently conducted an initial analysis. Their combined results identified 48 categories of experience expressed in the texts. A finalized set of 34 of these categories (“consensus categories”) were the results of inter-rater reliability tests by 20 further independent interpreters. The categories were derived from the astronauts’ descriptions of experiences they had as they looked outside of the Shuttle or ISS windows at either the earth or deep space.

Table 1. The 34 consensus categories of experiences had by astronauts

- Aesthetic appreciation
- Captured by view/ drawn to phenomenon
- Change (internal or bodily change)
- Connectedness (feeling connected with without losing distinctness)
- Contentment (tranquility, feeling relaxed or at peace)
- Disorientation
- Dream-like (feeling of unreality, abstract feeling)

- Elation
- Emotional (general emotional feeling or arousal)
- Experience-hungry (wanting more of a particular experience)
- Exteroceptive intensive experiences (sensory overload, silence)
- Floating (bodily, feelings of weightlessness)
- Floating in void (not related to weightlessness)
- Fulfillment
- Home (feeling of being at home)
- Inspired
- Intellectual appreciation (for order, analysis, complexity)
- Interest/inquisitiveness
- Interoceptive intensive experiences
- Joy (feeling of happiness)
- Nostalgia
- Overwhelmed
- Perspectival (spatial) change
- Perspectival shift (internal change of [moral] attitude)
- Peace (conceptual thoughts about)
- Pleasure
- Poetic expression
- Responsibility (towards others)
- Surprise
- Unity with whole (feeling of oneness with; holistic feeling)
- Unity of external (earth, universe, people on earth, interrelatedness)
- Scale effects (feelings of the vastness of the universe or one's own smallness/insignificance)
- Sublime
- Totality (wholeness of what is experienced; big picture)

These categories helped to define more general experiences of awe, wonder, curiosity and humility (AWCH). We specified the following operational definitions in terms of the 34 categories found in the texts.

**Awe:** A direct and initial feeling when faced with something incomprehensible or sublime.

*Specification:* Captured by view/ drawn to phenomenon; elation; experience-hungry, overwhelmed, surprise, scale effects.

**Wonder:** A reflective feeling one has when unable to put things back into a familiar conceptual framework.

*Specification:* Inspired; Perspectival shift; Nostalgia; Unity with whole; Unity of external; Responsibility.

**Curiosity:** Wanting to know, see, experience, and/or understand more.

*Specification:* Interest/inquisitiveness; Experience-hungry; Intellectual appreciation.

**Humility:** A sense one has about one's relation to one's surroundings or of one's significance.

*Specification:* Responsibility; Unity with whole; scale effects.

Here are some examples of the astronauts' texts with categories indicated in brackets.

I just noticed we were approaching London around midnight GMT. I decided to turn off all the lights and set myself up for some hopeful night shots. What an amazing, spectacular, incredible, mind blowing view! [**overwhelmed**]. So for a moment I just stared at the incredible display of life below me. From there we flew across the rest of Europe in a few minutes and I was just overwhelmed with the beauty of our civilization as it was, splattered across the dark landscape. [**overwhelmed; aesthetic appreciation**]

I went up to the flight deck to see the view, and wow, it was incredible [surprise; overwhelming] . The first sensation of looking out the window was very disorienting. Everything seemed to be floating - me, the shuttle, and the Earth, and all in different orientations. [**disorientation; floating; floating in void**]

Something else happened recently that will always be a special memory for me. I took a peek out the side-facing JEM windows one evening, without camera in hand, and was so mesmerized that I ended up gazing upon the Earth for an entire 90-minute orbit. Believe it or not, that is the first time I have done that. A hundred times I thought, "I should go grab the camera," but I decided to just try to capture this one orbit with my own eyes and burn it into my brain. ... [**captured by view**]

There is no way that I can imagine, especially after seeing our planet from this vantage point, that bringing our cultures closer together and proliferating understanding in our differences as well as our similarities, can be a bad endeavor. [**perspectival shift**]

### **Analysis of phenomenological interviews**

Following the simulation part of our experiments, we conducted a phenomenological interview with each participant. The analysis of the phenomenological interviews were used the 34 consensus categories developed in the hermeneutical analysis, and were then categorized into the broader AWCH categories. Accordingly, the astronaut texts were used as comparison points for participant reports. In the original hermeneutical analyses the categories were drawn from the astronauts' own words. We did not search for pre-defined categories. In the analyses of the phenomenological interviews we used the categories drawn from the astronauts' texts.

The hermeneutically-derived categories helped to shape of the design of the experiment, the structure of the phenomenological and psychological data collection, and the analysis of the neurophysiological results.

Here are some examples from the transcribed interviews with categories indicated in brackets.

### *First experiment*

It's a view [of Earth] that you don't see regularly ... and you don't really look at it from such a big point of view that everybody's on that small little planet, and you're so far away now. I think it just really makes you feel less important when you look at everything in such a view like that. You're just a speck on the Earth that's in a universe of many different planets [**Perspectival shift. Scale effects**].

I think it's the vastness of reality... to me, then I start thinking of how huge our universe is. Like, just looking at this and this is just a little part of what I'm looking at and how much more there is. That's the part that I admired... The beauty of the lights and all that, but, to me, somebody created all that. That blows me away. [**Scale effects**].

A little bit [of earth] was in view at the bottom. I was immediately much more drawn into that. It was... enthralling. Well it was exciting looking at the planet. [**Drawn to phenomenon**].

[I was] taken back, in awe, I was definitely admiring, definitely peaceful, relaxed, and then just like in awe of my mind taking me where I was really reflecting on how huge space is. [**Scale effects**]

### *Second experiment*

It kind of makes me reflect how I look at other people around the world, and what their struggles are and stuff like that. Looking at it from a different perspective, because with all the landmasses everything looks like it's either connected or it's all just a bunch of landmasses with no borders. It's a little mindblowing to see everything, just to see in that little space, everything that's going on. [**Perspectival shift. Scale effects**].

Just the concept that we're on a big rock floating in the middle of nowhere. I mean just the idea, that was like shocking. If you think about it like we're just here right now but if you look from space we're just floating, it's so big and massive and there's just nothing around it. It makes you wonder if we're here, we're inside earth, what's earth inside of? and what's that inside of? It just multiplies and it's just a really complex thought. (**Scale effects**)