

Phenomenological analysis

The hermeneutical analysis of the astronauts' journals and reports focused on their experiences. Phenomenology is a philosophical method that studies human experience from a first-person perspective – that is, from the perspective of the person who is having the experience. The hermeneutical analysis allows us to get to the astronauts' experience indirectly through their reports. On this basis we derived a set of 34 [consensus categories \[LINK TO “Textual Analysis”\]](#). We then used these 34 categories to analyze the transcripts of 92 phenomenological interviews conducted immediately after the simulation part of the experiments.

Phenomenological interview

The phenomenological interviews followed a set of procedures pioneered by a group of researchers associated with Francisco Varela's lab in Paris and has been used successfully in a variety of neurophenomenological studies involving perception (Lutz et al. 2002) and epilepsy (Le Van Quyen and Petitmengin 2002; Petitmengin 2010). The interview method is detailed in Petitmengin (2006). We understand the dynamics of the interview process in a slightly different way (Bockelman et al. 2013), but followed the basic procedures outlined by Petitmengin.

The phenomenological method derives from the philosopher Edmund Husserl (1913), and is summarized by Varela (1996) in three steps.

- **Suspension:** Husserl calls this the ‘phenomenological epoché’. The idea is to suspend all judgments, opinions, and theories you might have about what you are experiencing.
- **Redirection:** Husserl called this the ‘phenomenological reduction’. Following the *epoché*, the subject turns attention to the experience he or she is currently having (the lived experience).
- **Receptive openness:** the subject attempts to give the most precise description of his or her experience.

In most neurophenomenological experiments conducted by Varela's group the subjects were highly trained in either phenomenological method or Buddhist meditation technique that train attention. Using the phenomenological interview technique, the training of the interviewer is substituted for the training of the experimental subjects. The interviewer is trained to help the subject accomplish suspension, redirection and receptive openness using open questions to avoid introducing any biases or priming effects, keeping the subject focused on the lived experience, and eliciting more detailed descriptions.

Accordingly, the post-stimulus interview (lasting 30 minutes) was conducted to collect first-person reports of participant experiences during the simulation. Immediately following the simulation, a research assistant trained in the phenomenological interview technique interviewed the participant. In the first experiment the interviewer was different from the researcher who worked with the participant to connect/disconnect the neurophysiological sensors. In the second experiment, to better support rapport, the

same researcher who connected/disconnected the neurophysiological sensors conducted the interviews. The interviewers underwent rigorous training to be able to generate open-ended questions to support the participant’s self-reporting.

Analysis of the interviews

The interviews were transcribed and then analyzed for the occurrence of the consensus categories that indicated AWCH experiences. On this basis we were able to show that we replicated in the lab the same kind of AWCH experiences had by astronauts in space.

Here, for example, are some data from the first experiment. The most frequent experiences expressed in the interviews (totally 37,000 words) were:

- Perspectival shift (42 instances)
- Interest/inquisitiveness (22 instances)
- Contentment (22 instances)
- Exteroceptive intensive experiences (21 instances)
- Inspired (18 instances)

And here is how some of the numbers compare with occurrences in the astronaut reports.

Categories	Frequency in astronauts (23k)	Frequency in interviews (37k)
Aesthetic apprec.	17	14
Overwhelmed	11	7
Perspectival chg.	10	16
Dream-like	2	4
Scale effects	7	22
Experience hungry	4	6
Floating in void	4	6

Individual differences

The following results integrated the phenomenological results while drawing from the methodological practices of using individual differences to examine phenomena. The analysis is related to the tradition of case studies and necessarily cannot be extended as generalizable to the whole population; but that is not the goal in this form of analysis. Rather, this technique allows us to take seriously individual experiences as evident in the interview. Specifying the concepts of awe, wonder, curiosity and humility (AWCH) by the consensus categories (see [LINK TO “Textual Analysis”](#)) we were able to define a general distinction between AWCH experiencers and AWCH non-experiencers.

Participant 14 (P14), for example, a twenty-years-old female in the FOC group, expressed levels of experience in multiple categories including contentment, feeling

overwhelmed, perspectival (spatial) change, floating, and scale effects. During the interview process, the interviewers employed reflective language and open-ended questions that avoided the prompting and biasing of participants from using vocabulary from any of the target categories. The following interview excerpts provide examples of expressions of AWCH experiences:

“I think it was centered in on UCF and it comes out...and... I kind of like that feeling that it makes, I guess.... I don't know, I just like the way you feel when you feel like you are floating [floating] ...I'm comparing the earth to the stars, like what we see from earth type of thing. Um...and how we are just this little planet around all these stars, like it's weird to me...I guess just like how small the earth is compared to everything in the universe [scale effects]. I guess I was also thinking of like how different it looks looking into Earth compared to being on Earth and looking up...just kind of uh, overwhelming, [perspectival change; overwhelming] I guess...Cause it's, I don't know how exactly to describe it, it was just kind of surreal I guess how small earth is compared to everything else... The main thing that I was focusing on is, to me being on Earth it seems so big, but when you are really looking at Earth it's just, it's really small so it um...it was just kind of like a "awe" moment type of thing...how small the earth really is and how I think everything is so big and important when really we're like the small little planet. [scale effects]”

Participant 44 (P44), a nineteen-years-old female in the FOC condition, also indicated spiritual and aesthetic experiences during her interview. Her articulations included indications of all four AWCH, in addition to various related categories in spiritual, religious, and aesthetic experience.

“I was enjoying the different colors... like each star had like a different color, some were blue and some were like a white color. Then I noticed some of the other blue ones were moving...I just thought that they were really pretty [aesthetic appreciation] and that, um, I kind of... I guess I wondered if those were real stars or if they were, um, just kind of a picture. I actually thought about the Hubbell telescope once and wondered if this was like a real picture from like the Hubbell telescope?...I guess I was wondering where... what was taking this picture and, like making the formation. “It's kind of interesting to see because obviously you don't get that experience often because you're on Earth and so you're looking at Earth from being on Earth and walking around on it, but you don't really get that experience of looking down on it because very few people actually get to go into space [perspectival change] “It's almost overwhelming to just see everything you're experiencing, the stars and the water and the different continents all at once, [overwhelming] and so just looking... you're looking at pictures and saying, oh, this is China and, oh, this is what the sun looks like, and so instead you see like all of it all at once and you think, oh, this is what everything looks like put together... [unity of external] “... I guess when you see like a really pretty part of nature, like a waterfall or something. I guess, um, I kind of connect it to religion. I'm a Christian so I kind of connect it to God and how He's created these different places and He created the beauty, I guess, in your surroundings and stuff and there's just kind of a different perspective on the beauty that He's created, in my opinion... Um, I feel like for a split

second I thought of, this must be like what God sees when He looks down on Earth, but I don't think I... I didn't linger on the God aspect of it, no.

"...when everything is changing so quickly, you have so many thoughts all at once and you're kind of thinking about everything and you kind of, in a way, you get over...you get overwhelmed with thoughts [overwhelmed], but then at the end when nothing's...everything's pretty much the same and it's just now zooming out, you just kind of relax and you just take in the full picture instead of just little things at once." [contentment].

Not every participant shared these experiences. For example, participant 64 (P64), a twenty-years-old male in the FOC condition, reported nothing that the reviewers could categorize into any of the consensus categories. The same held for participant 65 (P65), a twenty-years-old female who also indicated no AWCH experience. Could such a high discrepancy in the reports be dismissed as purely behavioral (i.e. the "non-experiencers" could not or would not report unique experience)? In that case the neuro-physiological results should be similar between AWCH experiencers and AWCH non-experiencers. They were not (see [\[LINK TO "Neurophysiological analysis"\]](#))

The Experiment-Specific Survey of Experience (ESSE)

In the second experiment we complimented the phenomenological interview with a computer-based, Likert-scale survey, a demographic and experiential survey designed specifically for this experiment to provide quantitative data of the first-person experience (ESSE). After the phenomenological interview was conducted, participants completed the ESSE. The ESSE explicitly asked participants the degree to which they self-identify as a "spiritual person", "logical person", and "religious person". The ESSE also asked about the AWCH experiences. First, participants were given the working definitions of AWCH. Then, they were asked to what extent they agreed with a statement such as "While viewing the presentation today, I experienced AWE." They indicated the degree to which they experienced AWCH on a 100-point sliding Likert-scale.

The data collected in the present study confirmed that participants did experience AWCH, although they did not report significantly different degrees of these experiences on the ESSE. Of the total sample ($n = 74$, male = 39, female = 35), reports from the ESSE indicated awe experiencers = 70, wonder experiencers = 72, curiosity experiencers = 74, and humility experiencers = 62.

Correlations were run between persons who self-identified as spiritual, religious, and logical (these were non-exclusive categories, so one could self-identify as all three) to check for construct independence to better understand the difference, or lack thereof. Participants who self-identified as "spiritual" also identified themselves as "religious" at a significant level ($r = .764$, $p < .001$). They also significantly indicated experiencing wonder ($r = .253$, $p = .037$), but there was no significant correlation with the awe, curiosity, or humility.

Participants who, during the phenomenological interview, had expressed experiences of awe while viewing the experimental condition were categorized as "awe-experiencers" (n

= 39) or non-experiencers ($n = 22$). The participants who expressed an experience of awe during the phenomenological interview were significantly more likely to have reported awe in the ESSE as well, $t(34.018) = -2.374, p = .023$; Awe experiencers ($M = 19.69, SE = 3.626$) < non-experiencers ($M = 20.91, SE = 6.564$). While there was no significant relationship to wonder and curiosity, participants who expressed awe reported greater levels of humility in their psychological surveys; $t(39.00) = -2.356, p = .024$; awe experiencers ($M = 63.74, SE = 4.843$) < non-experiencers ($M = 42.95, SE = 7.377$).

From the ESSE we can also confirm in regard to what and when subjects were experiencing AWCH. The results indicated that awe and wonder emerge with a more distal view of the earth.

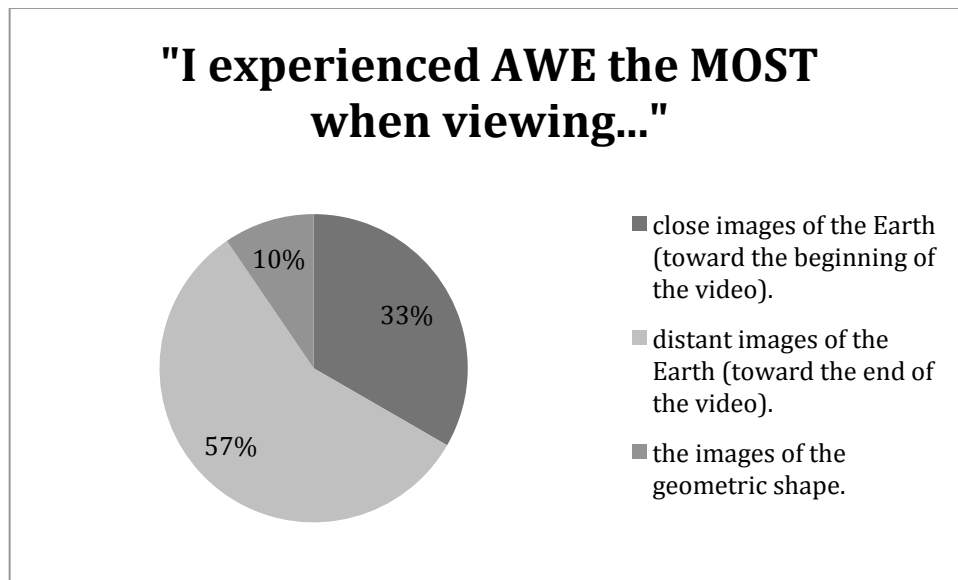


Figure 1. Simulation time for experience of awe.

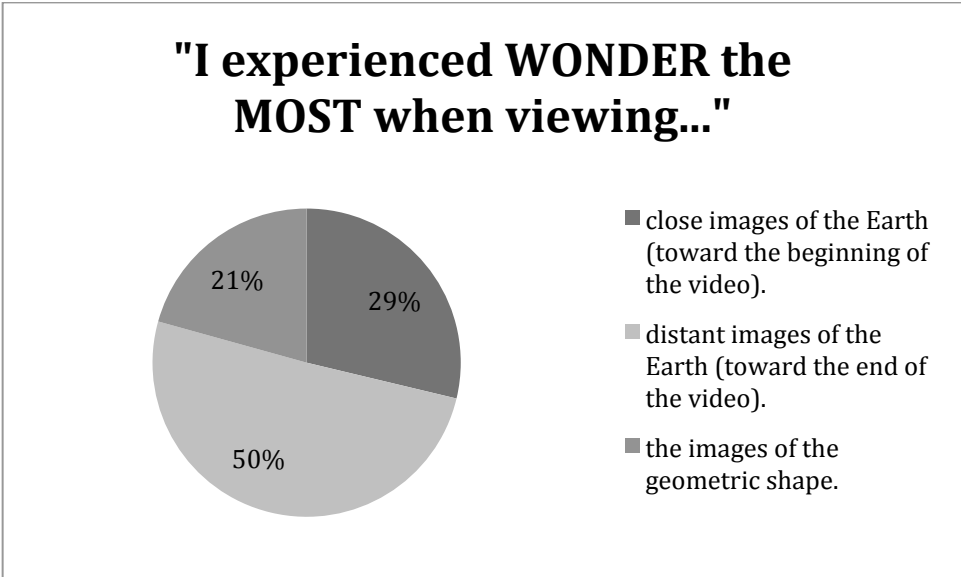


Figure 2. Simulation time for experience of wonder.

Curiosity, however related less to the distant view of the earth, with a similar number of participants falling into each category (Figure 3). Every single participant, regardless of group, reported experiencing curiosity. This was the only category from the core AWCH categories that was unanimously reported through the ESSE.

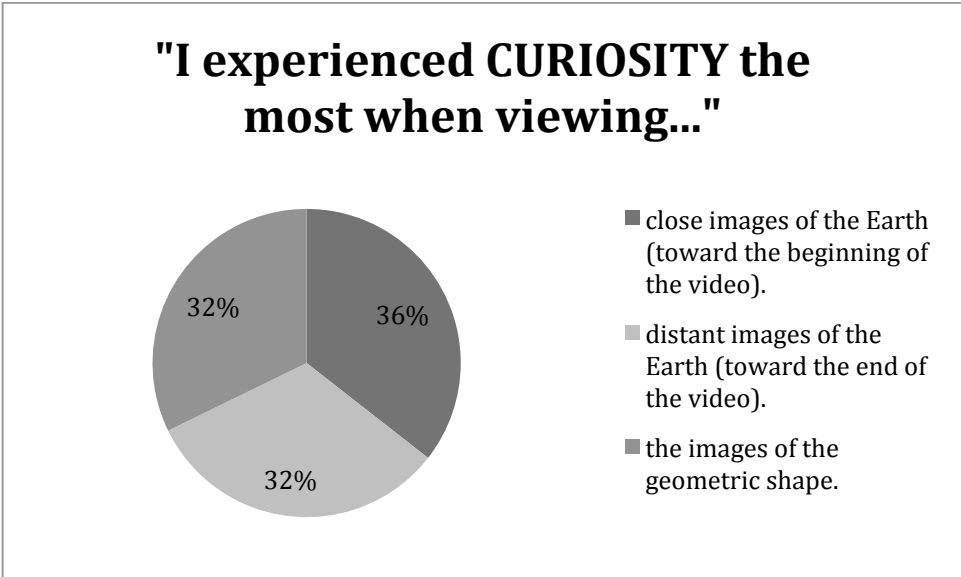


Figure 3. Simulation time for experience of curiosity.

Humility had the highest percentage of participants in agreement as to its elicitation along the simulation timeline (Figure 4). Participants were very unlikely to report that they had experienced it while viewing the control condition and most reported experiencing it when viewing the earth from afar, regardless of experimental condition.

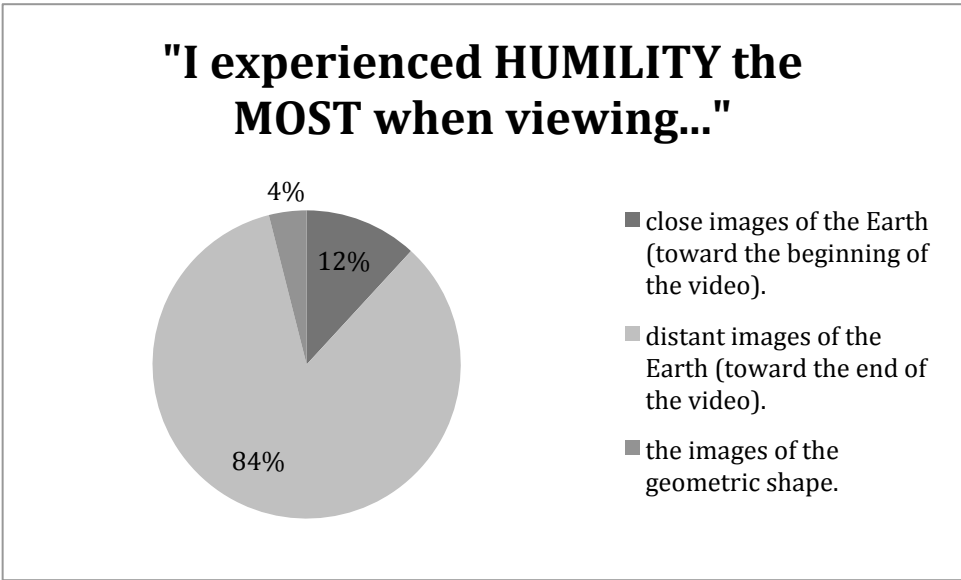


Figure 4. Simulation time for experience of humility.

It should be noted that the categories of AWCH experiencer or AWCH non-experiencer would have been absolutely different if relying on the self-reports in the psychological survey. As the chart below shows, the participants identified as AWCH experiencers (P14 & 44) in the phenomenological analysis would not have been categorized as such based on their survey alone; the AWCH non-experiencers also would not have been considered in such terms. For example, P14 gave a score of 12 out of 100 for awe ($M = 57.11$, $SD = 28.288$). On the other extreme, P65 reported 90 agreement with the experience of awe ($M = 57.11$, $SD = 28.288$), and 100 for wonder ($M = 67.75$, $SD = 25.962$) curiosity ($M = 75.64$, $SD = 22.098$), and humility ($M = 54.64$, $SD = 34.015$). This suggests that the ESSE can helpfully support interpretation of the data, but that the phenomenological interview is essential to get a clear picture of the target experiences.

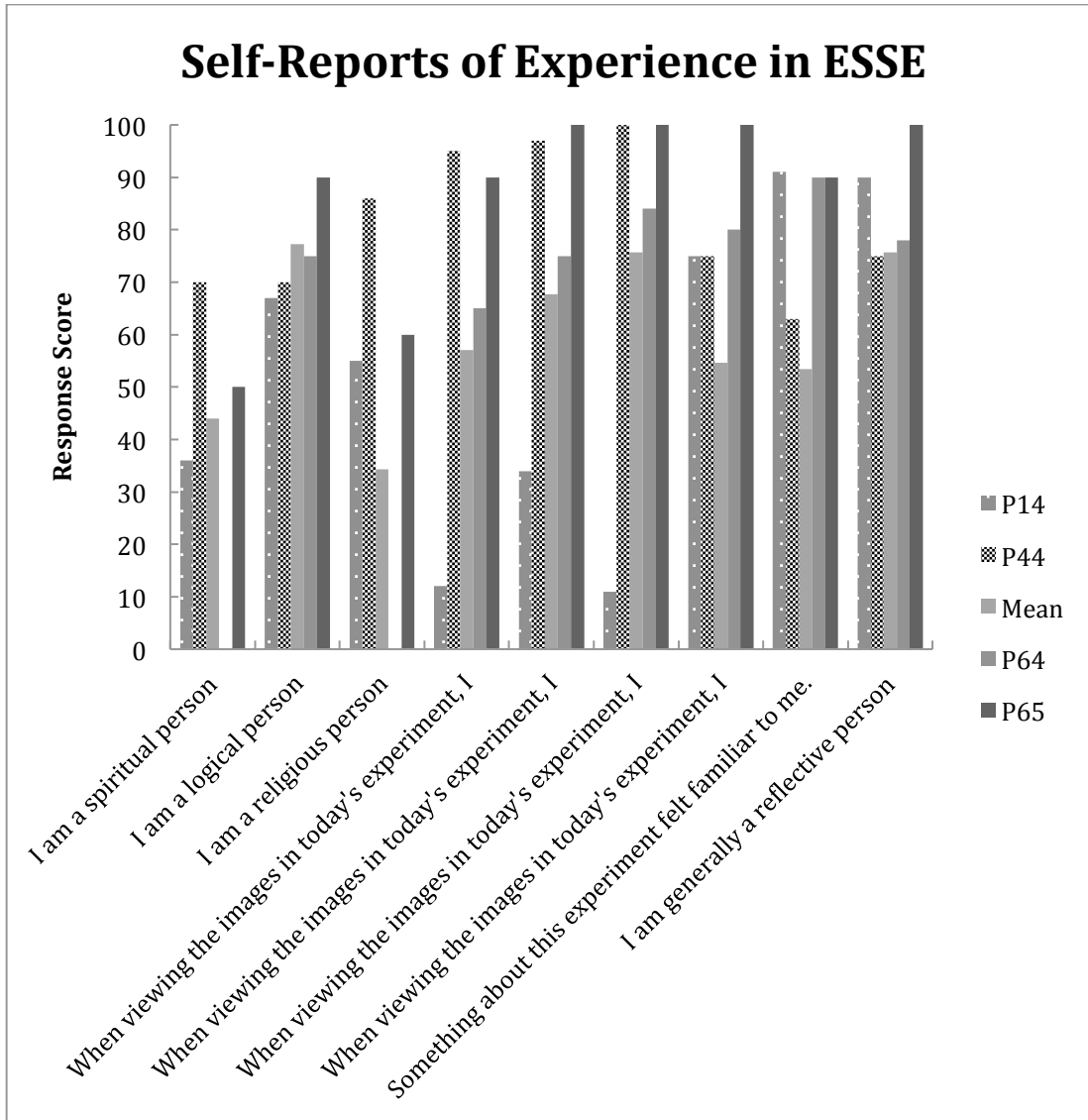


Figure 5. Self-reports of experience in ESSE. P14 and P44 were classified as AWCH experiencers in the phenomenological analysis; P64 and P65 were not.