How a Cartoon Series Helped the Public Care about *Rosetta* and *Philae*

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Once upon a time... is a series of short cartoons[1] that have been developed as part of the European Space Agency's communication campaign to raise awareness about the *Rosetta* mission. The series features two anthropomorphic characters depicting the *Rosetta* orbiter and *Philae* lander, introducing the mission story, goals and milestones with a fairy-tale flair. This article explores the development of the cartoon series and the level of engagement it generated, as well as presenting various issues that were encountered using this approach. We also examine how different audiences responded to our decision to anthropomorphise the spacecraft.

Introduction

In late 2013, the European Space Agency's (ESA) team of science communicators devised a number of outreach activities to engage the general public in the *Rosetta* mission, which was about to reach three milestones the following year: waking up from hibernation, and both rendezvousing with and landing on Comet 67P/Churyumov–Gerasimenko (Comet 67P/C-G). However, the spacecraft was launched in 2004, and had been in hibernation — meaning no contact with Earth — for almost three years, and it is fair to say that by 2013, it was known, but only to a specialised audience of space science professionals and enthusiasts.

Several activities were specifically designed to highlight *Rosetta's* expected exit from hibernation on 20 January 2014. The purpose of these activities, aimed at different target groups, was to (re)kindle curiosity about a mission that was largely unknown to most audiences, but that had potential for great public interest and appeal.

The activities included press briefings, the launch of new social-media channels dedicated to *Rosetta*, and a series of short videos to be distributed on the internet before the spacecraft came out of hibernation (Bauer et al., 2016). The four short videos were commissioned from the cross-media company Design & Data GmbH (D&D). They were intended to promote a Wake Up, Rosetta! campaign, run by ESA, in which members of the public were invited to take part in a competition by creating wake-up videos and sending them to ESA, symbolically helping to wake the spacecraft. The top prizes included an invitation to the comet-landing event in November (O'Flaherty et al., 2016).

One of the four short films used imagery related to alarm clocks, while a further two involved asking people on the streets of European cities to send a wake-up message to *Rosetta*, and what they normally did after waking up. These were both straightforward and direct. The fourth film played off the idea that some of the mission themes — the long adventure, the goal of unlocking the mysteries of comets and, most importantly, the spacecraft being asleep at the time and the imminent wake-up in January — resonated with the fairy-tale narrative of *Sleeping Beauty*. It was decided that the fourth video in the set should be a feel-good, family-friendly short film describing *Rosetta's* journey and highlights so far, and giving a taste of the exciting highlights to come, using the fairy-tale narrative as a base. The hope was that the video would help to build a degree of human empathy between the public and *Rosetta*.

The team originally envisioned a combination of illustrations and original footage from the mission presented in the style of a storybook, which would be released shortly before the winter holiday in advance of the spacecraft's wake-up call in January. The aim was to engage a wide public, but particularly school-age children.

The ESA team drafted the initial storyline for the *Once upon a time…* video and then worked with the creative team at D&D on further development. D&D suggested producing the video as a fully-fledged cartoon, embracing the benefits of visual storytelling to make the mission more accessible. They built on the original ESA storyline to demonstrate this concept, creating a first script for the video. In the process of drawing the shapes of the *Rosetta* and *Philae* probes to represent a simplified, but distinctly recognisable version of each spacecraft, the two characters took shape, and anthropomorphic features — such as arms, a mouth and eyes — were added.

Figure 1. *The first cartoon concept proposed in late 2013. Credit: Design & Data*

Figure 2. *Early sketches showing the development of the* Rosetta *and* Philae *cartoon characters. Credit: Carlo Palazzari*

The first concept illustrations developed by D&D were promising and the ESA team bought into the vision, agreeing to use a cartoon video to promote *Rosetta's* wake-up competition alongside the three other clips produced by D&D.

Cartoons and personification of spacecraft

The cartoon, presenting *Rosetta* and *Philae* as two brave, cheerful explorers on a fun and pioneering journey across the Solar System, was released on 20 December 2013. In a little over two minutes, it described the mission's launch, the planetary and asteroid flybys, and the long cruise up to the point when the spacecraft, far from the energy of the Sun, fell asleep. In true fairy-tale style, the video ended with *Rosetta's* anticipated wake-up and an enticing "To be continued..." message.

The video, with a narration originally only in English, was published on ESA's websites and YouTube channel, and promoted with ESA's social media channels, as well as via the *Rosetta* mission Twitter and Facebook accounts (Baldwin et al., 2016). It proved quite successful, registering over 49 000 views on YouTube in the six weeks following its release.

Although there are precedents from other outreach campaigns for personified space probes, landers, and even fundamental particles, this was the first time that such an approach had been taken for ESA's main tier of communication[2]. Nevertheless, after the release of this first cartoon, we received

very enthusiastic messages from many members of the public who appreciated the clear content and fresh style delivered by the animation.

Building on the saga

The positive response to the introduction of the characters led to additional cartoon episodes and a continuation of the narrative as mission events unfolded and the overall *Rosetta* communication campaign developed during 2014.

The collaboration between ESA and D&D continued. For each episode, the ESA team started by writing the script and outlining a rough storyboard, after which the D&D team created a draft animation (with a placeholder narration) on which the ESA team commented and suggested edits. This lengthy review process was necessary to ensure that the content of the cartoons was not only visually and audibly engaging, but also factually correct in terms of accurately representing the course of events, as well as the scientific and engineering aspects of the mission. Based on the feedback provided the D&D team would then produce the fully animated version of the episode, recording the narration with a voice actor and including a music track. After final iterations to check that every detail was correct, the ESA team would publish the episode and promote it on ESA's online channels.

Ahead of *Rosetta* arriving at the comet in the summer of 2014 the cartoons were used to create a trailer to promote the

Rosetta, are we there yet? competition conveying the feeling of being on a long journey and the excitement of reaching one's destination (O'Flaherty et al., 2016). Following this a second full episode was released. Longer and more involved, this episode covered the events that followed the successful wake-up, including taking first images of the comet, planning rendezvous manoeuvres, dreaming of future scientific investigations, and, finally, the arrival. In both videos, the personalities of the spacecraft characters were further developed, with *Rosetta* pictured as a calm, reliable pilot and *Philae* as a curious passenger, impatient to arrive at the comet.

The third full episode was released just a week before rendezvous on 6 August 2014. At that time, the ESA team had also been investigating another of the mission themes: the role of comets in the history of science[3]. The team had considered including some highlights from this fascinating story in the arrival episode, but realised that this subject deserved its own episode — this became *Fabulous Fables and Tales of Tails*.

It was imagined as a story that the *Rosetta* and *Philae* characters may have read on their journey, narrated by a grandfather figure represented by ESA's *Giotto* spacecraft which, in 1986, was the first spacecraft to make close-up observations of a comet. In this four-minute-long episode, *Giotto* and a handful of probes from other space agencies were also anthropomorphised, as *Giotto* recounted stories about their various cometary missions. The episode also featured human characters from the history

Figure 3. *Selected scenes and characters from the cartoon. First row:* Rosetta *and* Philae *during launch; people on Earth shouting "Wake Up, Rosetta!";* Rosetta *and* Philae *finding directions in space;* Rosetta *catching comet dust. Second row:* Rosetta *taking a photo; Grandfather* Giotto *taking a photo;* Philae *and his sandwich;* Rosetta *and* Philae *ready for comet landing. Third row:* Philae *studying the comet surface;* Rosetta *adjusting her antenna after wake-up (*Philae *still sleeping);* Philae *sleeping on the comet, dreaming of* Rosetta*,* Giotto *and previous comet chasers from other space agencies;* Philae *wearing his landing gear. Fourth row:* Rosetta *falling asleep; baby pictures of* Rosetta *and* Philae*; mission controllers at ESA celebrating after* Rosetta's *wake-up. Credit: ESA*

of science, including ancient Chinese and Greek scientists, as well as astronomers from more recent times, such as Tycho Brahe and Edmond Halley.

Communicating risk and managing expectations

The fourth major episode in the series was released one week before the historic comet landing on 12 November 2014, describing *Rosetta's* scientific activities during the first months at the comet, the selection of *Philae's* landing site, and the preparation for sending *Philae* to the comet's surface. The science experiments were represented through metaphors (Arcand et al., 2014), for example, tasting water from the comet's atmosphere and collecting dust particles with a vacuum cleaner. *Philae's* equipment was also portrayed in a similar way, including a helmet, headlamp, camera, compass, pickaxe and snow boots. In addition, we decided to add a sandwich to *Philae's* backpack, to indicate that the lander would need an independent source of energy to operate on the comet's surface.

While these visual storytelling elements provided us with a helpful tool to commu-

nicate the various operational and scientific aspects involved in the landing in a charming yet accurate way, a long-standing concern with this approach came fully into focus during and after the production of this episode. The real probe *Philae* was about to be sent on a risky, one-way journey that would ultimately end in it dying on the surface of the comet. But having turned both *Rosetta* and *Philae* into lovable anthropomorphic characters, how could we represent that risk in a truthful and yet sensitive way?

This aspect became even more relevant in the wake of the unplanned nature of the actual landing events. After *Philae* touched down at the originally planned landing site, it was unable to secure itself to the surface and then rebounded, travelled above the surface for over two hours in a number of bounces, before finally coming to rest over a kilometre from the initial touchdown point. In a strange coincidence, a scene in the fourth episode showed *Philae* daydreaming of the landing, including repeated bounces off the comet surface. This was included to help manage expectation of the risks of landing in a general sense, but was by no means a premonition of what was to come!

Beyond that, *Philae* had landed in an unexpectedly dark location where there was insufficient sunlight to charge the probe's secondary batteries. After almost three days of successful scientific operations, *Philae* exhausted its non-rechargeable primary battery, fell into hibernation, and lost contact with *Rosetta*. Addressing these non-nominal outcomes and the premature demise of *Philae* in terms of its anthropomorphic incarnation became the key challenge involved in the production of the fifth cartoon episode, ahead of its release in early 2015. We could not just say that *Philae* had "died".

In fact, the anthropomorphic approach helped us by making it possible to present *Philae's* risky and difficult tasks, as well as the unexpected chain of events, in terms of common feelings: fear, surprise, commitment, and even humour. The issue of the lander going into hibernation was communicated by explicitly drawing attention to *Philae's* battery level dropping on an indicator familiar from mobile phones (a visual metaphor that had also been used in the very first episode to describe *Rosetta's* hibernation) and stating that he had fallen asleep on the comet's surface, rather than having died. This was reinforced by showing him dreaming about the plaudits he might expect from the other comet missions as previously anthropomorphised in the *Fabulous Fables and Tales of Tails* episode, and also of possibly waking up again later in the mission.

This approach appeared to go down well with the cartoon audience, with a lot of sympathy expressed for the anthropomorphic *Philae*, as well as hope that he would awake from his slumber. When *Philae* did indeed wake up again and make contact with *Rosetta* on 13 June 2015, a cartoon still image prepared in advance became the main visual element for communicating this momentous news worldwide. This wake-up image was featured prominently online, as well as by traditional media.

The sixth and latest full episode in the series to date was published in November 2015, and mentioned *Philae's* wake-up in June, the difficulties in establishing communications between orbiter and lander, and reaching perihelion — the comet's closest point to the Sun along its orbit — in August 2015. But the principal focus of the episode

Figure 4. An Italian newspaper's report on *Philae's wake-up in June 2015, including the tweet from @ESA_Rosetta featuring the cartoon.*
Source: La Stampa*, Italiana Editrice S.p.A.*

was on *Rosetta's* activities during the first year at the comet, drawing attention back to the orbiter and its extensive set of scientific experiments. Once again, the experiments and their results were represented through a series of visual metaphors.

Narrative, aesthetic and cross-media choices

As the personalities of the *Rosetta* and *Philae* cartoon characters developed, a number of other issues emerged.

From the outset, we did not wish to associate any stereotypical gender characteristics to the characters: both were intrepid explorers undertaking a risky adventure together. We nevertheless did choose to use he/she pronouns to help viewers, especially children, engage with and follow the single-voiced narration.

We decided that *Rosetta* would be a female character, most obviously because the name is a common female name in many languages. But that immediately brought with it the strong message that *Rosetta*, a bold explorer on a pioneering mission to study the origins of the Solar System, was a representation of the many great women working in science and engineering. Even before the cartoons first appeared we had been encouraged by some leading women in the fields of astrophysics and space science to present *Rosetta* as a positive female role model, and the anthropomorphised version made that eminently possible.

Then, simply for balance, *Philae* was identified as a male character. However, to treat the two characters equally and to avoid both a stereotyped nurturing connotation for *Rosetta* and possible emotional escalation around the time of landing, we decided that *Rosetta* would not be a mother to a son *Philae*, but that the two probes would be described as siblings[4]. In the history episode, *Giotto* took the role of their grandfather, while the more recent NASA missions, *Deep Impact* and *Stardust*, were regarded as cousins.

Regarding the animation style, the D&D team opted for a two-dimensional rather than three-dimensional animation. Aesthetically, the appeal of a simple, reduced representation of the spacecraft was chosen instead of an overly detailed one. The images appear as watercolours drawn on rugged paper, with a range of blue hues suggesting a dreamy environment in outer space. At times, the texture of the paper was left visible in the video, some of the coloured areas appear not to be completely filled, and features like contour lines were deliberately left rough. This approach was chosen to convey the feeling of an almost handmade product, although of course production time and budget constraints also played a role.

Within this graphical context the spacecraft themselves were drawn in a very simplified form, rather than in any kind of more lifelike representation, in part to avoid getting anywhere close to the well-known Uncanny Valley concept[5], and also to appeal to a broad range of viewers across different target groups and cultures. One exception to this highly stylised approach was that in later episodes, as the mission and its imagery gained wider recognition, we decided to include real images of Comet 67P/C-G in selected scenes of the cartoon, interspersed with artistic representations.

Similar considerations were taken into account in the choice of the voice actor for the narration. Among those auditioned we searched for a warm, fairy-tale feel so that the narration would resemble that of a grandparent telling a story to the family. The final choice of an American voice actor also ensured wider engagement with worldwide audiences, used to the voices of Hollywood actors.

The music used in the films, under the supervision of executive music producer Rolf Maier-Bode, accompanies the journey of *Rosetta* and *Philae* in the classical storytelling model of the Hero's Journey[6]. A predominantly relaxed, orchestral sound was used, in contrast to a more dramatic style commonly identified with space and science fiction. Various repeated themes were used across the arc of the cartoons[7], and only limited sound effects were employed, to avoid distracting from the narration.

Although initially the narration was only in English, a clear demand for additional languages arose once the cartoons became popular, especially for younger audiences in non-native English-speaking countries. Subsequently, each episode has now been released in five major European languages, namely English, French, German, Italian, and Spanish, each with its own dedicated narrator.

Beyond the films themselves, the ESA team also exploited the crossover between the
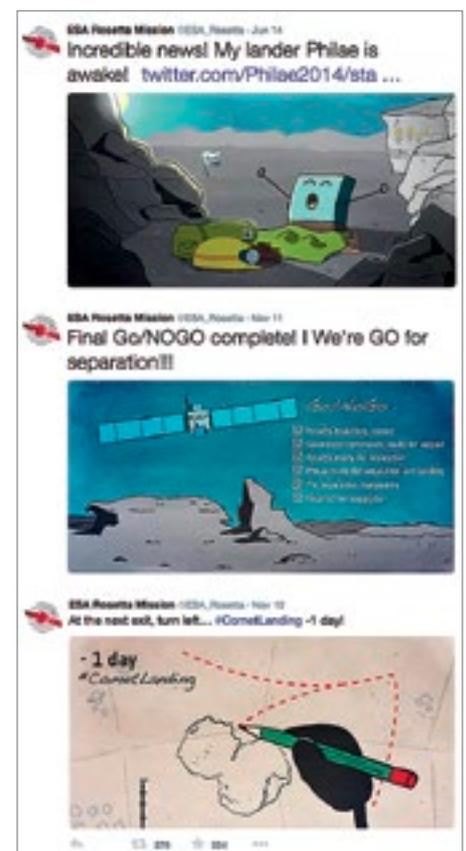
Figure 5. Examples of cartoon scenes used in the tweets from @ESA_Rosetta. Credit: ESA

anthropomorphic spacecraft depicted in the cartoon series and the characters of *Rosetta* and *Philae* that were taking shape in the interactions between the first-person @ESA_Rosetta and @Philae2014 Twitter accounts, which often engaged in friendly conversations about their journey and adventures together[8]. Particularly in the weeks leading up to landing, tweets were often accompanied by images from the cartoon series in order to further reinforce the connection between the fictional spacecraft characters and the mission's human followers (Baldwin et al., 2016).

Current status of the cartoon series

To date, six episodes have been released, plus a brief trailer for the Rosetta, are we there yet? competition. In addition, a compilation of scenes drawn from various episodes (but also including some brief new elements) was shown on screens throughout Schiphol Airport in Amsterdam without narration for several months at the end of 2015.

To date, the total viewing numbers for all the videos combined is more than 1.8 million[9]; for the full six episodes, the average viewership thus far is about 280 000, and the most-watched episode — featuring the preparations for landing on the comet — had reached over 900 000 views by the end of 2015.

At the time of writing, we intend to continue the cartoon series throughout the mission's operational lifetime. A number of episodes are envisaged in 2016 emphasising the main scientific discoveries of the mission, and leading up to the final planned controlled impact of *Rosetta* on Comet 67P/C-G at the end of September 2016. We then plan to complete the series with a final long compilation, integrating all episodes with small edits to ensure a good flow, covering the entire history of *Rosetta* and *Philae's* mission.

Analysis

All the elements described above resulted in the cartoon series making a significant contribution to personalising the mission and connecting with audiences, with the result that many members of the public made it clear that they empathised with the
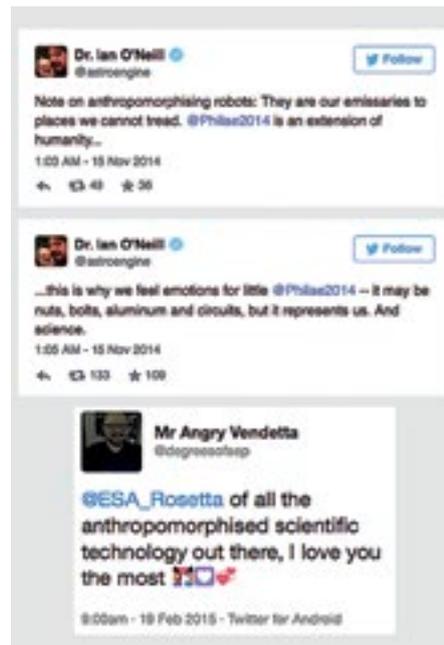

Figure 6. Examples of Twitter messages about the anthropomorphic cartoon characters. Source: Twitter

two spacecraft and cared for their wellbeing. This was mainly evident in the social media sphere, especially on Twitter and Facebook, where many users have commented on the successes achieved and challenges faced by the spacecraft in personal terms, often expressed using very human emotions. Many adopted the cartoon characters as their own avatars and many thousands have shared them with their own contacts.

It is very unlikely that many people (apart perhaps from the very youngest children) actually thought that *Rosetta* and *Philae* were anything other than unintelligent robots mostly controlled from Earth. However, the willingness to suspend disbelief and engage with anthropomorphised machines, animals, and completely fictional characters is a very common human characteristic exploited in a wide range of storytelling arenas, and it is clear that we tapped into this with the combined cartoon and first-person approach. People identify with *Rosetta* and *Philae* because they are, in some sense, our representatives in the very human desire to explore the Universe.

The empathy perhaps peaked on the night of 14 November 2014, in the final few hours before *Philae's* primary battery ran out, and as the two spacecraft conversed back and forth via Twitter. People

Figure 7. An example of Rosetta-*themed Christmas decorations in December 2014. Source: Twitter*

following the live tweets from the two mission control rooms in Darmstadt (ESA) and Cologne (Deutsches Zentrum für Luft- und Raumfahrt, DLR) shared intense and quite probably genuine emotions of tension, sadness, but also joy and pride at *Philae's* achievements (Baldwin et al., 2016). There was also a very positive emotional reaction when the lander made contact with the orbiter again in June and July 2015.

Beyond ESA's own communications output, the personified cartoon characters and first-person tweets were also very widely used in stories about the mission by news outlets worldwide, and the overall anthropomorphic approach we have taken to *Rosetta* and *Philae* has been discussed and analysed in articles, blogs, podcasts, and mainstream media[10].

Outside of the 2D confines of the online films, the cartoon characters lent themselves to a variety of physical spin-off products. Stickers featuring scenes from the cartoon episodes were produced and distributed during public events, and a cut-out-and-make 3D paper model[11] of the two main characters was made available online for the Rosetta, are we there yet? competition in 2014. The characters were also featured on a series of products for purchase, including T-shirts, sweatshirts, and a soft toy: these have all proven very popular[12].

Figure 8. *The planetarium team at the Techmania Science Center in Plzeň, Czech Republic, wearing* Rosetta *and* Philae *cartoon T-shirts in front of the spacecraft scale model. Source: Facebook*

Selected internet comments on the cartoons and the anthropomorphic representation of *Rosetta* and *Philae* posted on ESA's public channels:

Awesome cartoon. We love it. We need more [of] this so space-related science gets attention from our kids

I saw all the videos about Rosetta *and* Philae*, and they are really amazing, full of humility and educational content, and the animation is simply inspiring*

Cheers! I totally loved those cartoons — made me fall in love with the mission and its adorable protagonists!

Do you know when the next cartoon is scheduled for release? I have a class of 14 year olds who want to see Philae's *adventures on the surface*

Members of the public also created their own versions of the cartoon representations of *Rosetta*, *Philae*, and the comet — ranging from baked goods to masquerade costumes and nail art — sharing many photos of their creations on social media channels. In December 2014, shortly after the landing, we were surprised by the number of Christmas decorations inspired by the mission themes that were spontaneously posted on Facebook and Twitter.

Based on comments received on ESA's websites and social media platforms, the public response to the anthropomorphised spacecraft has been very positive overall. As a simple quantitative metric, the average like-to-dislike ratio of the cartoon episodes on YouTube is a hundred to one.

Overall, there was very little criticism of the approach, but that which did arise was mostly limited to tech-savvy space enthusiasts who deemed cartoons to be childish and did not appreciate the level of simplification adopted in the narrative. However, this ignores the fact that cartoons were just one of several facets of the broad *Rosetta* and *Philae* communication campaign run by ESA and its partner institutions. This campaign included a huge variety of products to appeal to and engage many different audiences, including images and data from the various instruments; news and updates about the technical and scientific aspects of the mission; in-depth articles; video material; interviews with mission experts and even a short science fiction

film (McCaughrean, 2016). All of these outputs were accompanied by an extensive social media presence. It is clear that no single approach can engage all possible audiences and we have clearly seen that many people appreciate receiving information in a variety of forms: many amateur and expert space enthusiasts were just as taken with the cartoons as they were with technical details.

In the same vein and as an added and perhaps unexpected bonus, the anthropomorphised *Rosetta* and *Philae* have also been very well received within the scientific community. Many scientists and engineers involved with the mission have reported that they use the cartoon material extensively when giving public talks, especially in schools. Some *Rosetta* scientists have been sighted wearing cartoon-themed clothing at conferences, and plenty of scientists and engineers worldwide, covering many different disciplines, commented positively on the cartoons and adopted *Rosetta* and *Philae* avatars for their social media presence.

Finally, in further external validation, the cartoon series has featured a few times among the many prizes that the mission and its communication campaign have been awarded over the past year. These include the Fast Forward Science Award from Wissenschaft im Dialog and the Stifterverband für die Deutsche Wissenschaft in Germany in December 2014, and the New Media (non-interactive)

prize at the EuroPAWS Science TV & New Media Festival, held in Lisbon in November 2015. The cartoons were also shortlisted in the European Excellence Awards, honouring outstanding achievements in the field of public relations and communication in Europe, and for the Deutscher Preis für Onlinekommunikation in Germany.

These qualitative observations suggest that the medium of visual storytelling can be used to develop a clear and engaging narrative to communicate complex technical and scientific topics, and that a careful use of anthropomorphic characters in the dissemination of space science missions has the potential to be widely appreciated by a variety of audiences. With *Rosetta* and *Philae*, this has worked extremely well, and it seems likely that their anthropomorphic avatars will live on in the public sphere long after the mission itself is over.

Acknowledgements

Notes

[1] Links to all episodes of ESA's *Once upon a time...* cartoon series can be found here: http://sci.esa.int/rosetta/53593-outreach-resources/#once-upon-a-time

[2] There are already precedents for a personified approach to public communication of space science. Several spacecraft, most notably NASA's *Phoenix* and *Curiosity* landers on Mars, have first-person Twitter accounts (Vertesi, 2010) and the ESA science communication team had already decided that *Rosetta* would also adopt a first-person voice before making the cartoons. Other examples include an illustrated booklet (in Japanese) written in 2010 which told the story of JAXA's asteroid sample-return mission *Hayabusa*, featuring anthropomorphic spacecraft and planets (http://www.isas.jaxa.jp/j/enterp/missions/hayabusa/fun/adv/index.shtml); the Istituto Nazionale di Fisica Nucleare animated video (in Italian) called *Nino il Neutrino*, produced in 2008, featuring anthropomorphic particles flying through space and explaining fundamental physics concepts (https://youtu.be/mSQ3w3IcVSM); and in 2003, ESA's development of the anthropomorphic Paxi character, an alien exploring outer space, for its ESA Kids education website (http://www.esa.int/esaKIDSen/).

[3] A history of comets is available here: http://sci.esa.int/rosetta/54198-harbingers-of-doom-windy-exhalations-or-icy-wanderers/

[4] Interestingly, members of the public who mention the characters of *Rosetta* and *Philae* on the ESA social media channels have referred to them in different ways: from siblings to mother and child, and even, in some cases, as lovers.

[5] The Uncanny Valley is a concept that has been researched in the field of aesthetics and was first identified by Japanese roboticist Masahiro Mori as *Bukimi no Tani Genshō* (不気味の谷現象) in 1970. The term itself first appeared in the 1978 book *Robots: Fact, Fiction, and Prediction*, by art critic and curator Jasia Reichardt. The idea is that consumers of animated movies and games can develop an antipathy towards avatars that aim (but ultimately fail) to get as close as possible to human-like characteristics. Instead, there seems to be a preference towards a certain degree of abstraction in slightly unrealistic anthropomorphic figures.

[6] The Hero's Journey (or monomyth) is a universal pattern that has been used by storytellers around the world for millennia. It involves a heroic character who goes out on an adventure, faces and overcomes challenges and crises, and returns after a major change or transformation. Joseph Campbell first described it in his 1949 book *The Hero with a Thousand Faces.*

[7] An example of a repeated theme used in the animation's score is the simple fifth interval in the melody at the beginning of the first episode, resembling a fanfare. This was chosen to match the first scene of the episode, showing a rocket launching into the sky — an iconic image for space exploration. The overall motif was chosen to remain wary and emotional, to convey the sense of uncertainty in the mission's future at the time of launch; for this reason the fifth interval was played in a delicate way. To fit with the fairy-tale style of the drawings and narration, the bold, adventurous fifth interval from the first scene was eventually matched to an overall charming, rather gentle melody.

[8] The ESA science communication team manages the @ESA_Rosetta Twitter account, while the @Philae2014 account is managed by the DLR. Many of the conversations between the two accounts were co-scripted in advance.

[9] The view counts are cumulative across ESA's website and YouTube channel (including all five languages). The videos have been republished by many independent online channels and translated into other languages, but these viewing numbers are not included here.

[10] Examples of news outlets using the cartoon characters in their reporting include *Washington Post* articles by Rachel Feltman on *Rosetta* and *Philae* communications (https://www.washingtonpost.com/news/speaking-of-science/wp/2014/11/15/why-we-all-fell-in-love-with-rosettas-philae-lander/); a *Flow South Africa* blog post by Stuart Buchanan on the social media strategy used for *Rosetta* (http://www.flowsa.com/blog/entry/cometlanding-a-social-media-strategy-thats-out-of-this-world/) and *The Cosmic Shed* podcast on the *Rosetta* communication campaign (http://thecosmicshed.podbean.com/e/bonus-episode-ambition/).

[11] The *Rosetta* and *Philae* paper model is available here: http://esamultimedia.esa.int/docs/*rosetta*/RosettaModel.pdf

[12] The *Rosetta* online shop managed by D&D is here: http://www.rosettashop.eu/

References

Arcand, K. et al. 2014, Communicating Astronomy with the Public, 15

Bauer, M. et al. 2016, Communicating Astronomy with the Public, 19

Baldwin, E. et al. 2016, Communicating Astronomy with the Public, 19

McCaughrean, M. et al. 2016, Communicating Astronomy with the Public, 19

O'Flaherty, K. et al. 2016, Communicating Astronomy with the Public, 19

Vertesi, J. 2010, Communicating Astronomy with the Public, 10

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