Editorial Commentary | Palliative Medicine and Palliative Care for Serious or Advanced Diseases

The uncanny valley and the "Hello Kitty effect" in facial palliative reconstructive surgery※

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Despite the evolution of reconstructive techniques, head and neck defects still pose a challenge for the reconstructive surgeon. Primary goals of reconstruction remain the restoration of functional and aesthetic integrity of the maxillofacial facial system. The former aims to maintain an intact alimentary tract and intraoral seal, whereas the latter aim to restore facial appearance and expression. Free tissue transfer has revolutionized the field of facial reconstruction, making these goals a reality. However, in cases of extensive tridimensional composite oromandibular defects, which usually occur after oncological resection and involve bone, oral mucosa, external skin and soft tissue, restoration of a completely normal appearance is almost impossible. Finally, despite surgeons' best efforts, many facial anatomical structures are irreplaceable and extremely difficult to reconstruct.

Even though the success of reconstructive surgery in terms of functional outcomes is easily assessed, the aesthetic outcome that is considered acceptable in these patients is not clearly defined. In certain cases, less is more and there is no need to perform further surgeries to achieve an optimal aesthetic result, simply because it is not possible. In fact, multiple surgeries may have a negative impact not only on the patient's burden, but paradoxically, also on the final aesthetic outcome itself. Most of the elements of the aesthetic appearance are instinctive and difficult to define, which means even technically good results can be intuitively cosmetically unpleasant.

We herein present a 64-year-old patient with a very extensive composite midfacial defect reconstructed with a double free-flap. The alimentary tract was fully restored and the final aesthetic outcome deemed satisfactory, even though no bone reconstruction was done. We attribute this paradox to the uncanny valley effect, a well-described phenomenon that remains unknown in reconstructive surgery. Moreover, we introduce the term "Hello-Kitty effect" to frame the limits of reconstruction in such patients.

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee(s) and with the Helsinki Declaration (as revised in 2013). Written informed consent was obtained from the patient for publication of this article and accompanying images. A copy of the written consent is available for review by the editorial office of this journal.

A 64-year-old patient with a locally advanced oral squamous cell carcinoma, involving the mouth floor, both mandibles, lips, as well as the external skin (*Figure 1A*), presented to our department. A computed tomography (CT)

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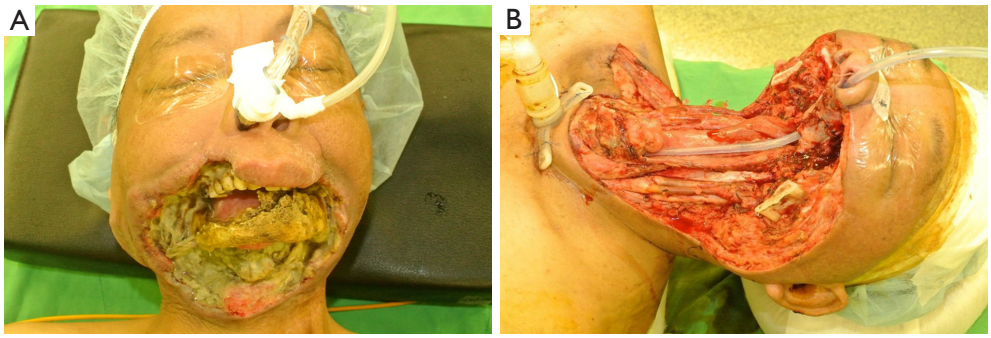

Figure 1 Preoperative view of the patient with a locally advanced oral squamous cell carcinoma, involving the mouth floor, both mandibles, lips, as well as the external skin. (A) Intraoperative patient view before excision. (B) Intraoperative view of a patient with extesive midfacial defect due to oncologic resection for squamous cell cancer (supine position). The patient was reconstructed with two ALT flaps (one for the alimentary tract-tubing and upper face and one for the lower face). This image is published with the patient's consent. ALT, anterior lateral thigh.

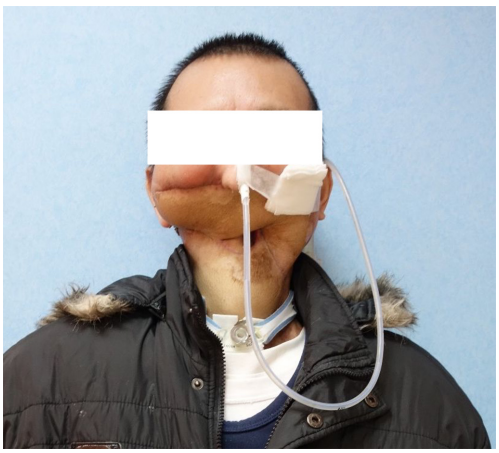

Figure 2 Postoperative result, three months after surgery. The patient was very satisfied with the result, admitting he had expected a monstrous appearance. He reported his and others' perception of his appearance to be cute. We attribute this paradox to the uncanny valley phenomenon. This image is published with the patient's consent.

scan was performed and confirmed bone infiltration, with evidence of distant metastasis. The tumor was histologically confirmed. In the presence of malodorous tumor with distant metastatic disease we recommended surgery to improve quality of life. The patient was informed that anatomical structures had to be removed and, dependent on the defect, the best reconstructive option would be considered. He consented and was scheduled for surgery. Intraoperatively, after total resection of both mandibles, both lips and removal of the infiltrated soft tissue, a huge defect remained (*Figure 1B*), which was covered with two free anterior lateral thigh (ALT) flaps. The first ALT was splitted and one part was used for tubing to reconstruct the alimentary tract. The second part was used to cover part of the defect of the upper face. The defect of the lower face and the neck was covered with the second ALT flap. Both donor sites were closed primarily. The postoperative course was uneventful and the wound healed primarily within 3 weeks. The patient was very satisfied with the result, admitting he had expected a monstrous appearance. He presented once for follow-up, three months after surgery (*Figure 2*). He reported his and others' perception of his appearance to be cute. Sadly, he passed away almost two years after reconstruction due to cancer complications.

We herein presented a patient with an extensive composite facial defect, after oncological resection. The patient underwent one-stage double free flap soft-tissue reconstruction. The final aesthetic result was satisfactory, giving him a "cute" appearance, without the need for bone reconstruction. We attribute this paradox to the uncanny valley effect.

The uncanny valley phenomenon was initially described by the Japanese roboticist Mori *et al.* in 1970 (1). It originally referred to the emotional response against the similarity of a robot to human appearance. Mori observed that, the more human-like appearance a robot has, the more familiar and pleasing to a viewer it seems. However, this positive perception turns into unease and discomfort when the degree of the robot's human-likeness reaches a stage at which it is very close to being human, but not fully. At this point (about 80–85% human-likeness) the robot's subtle differences to real human appearance are exaggerated and created an opposite effect and in fact perceived as more

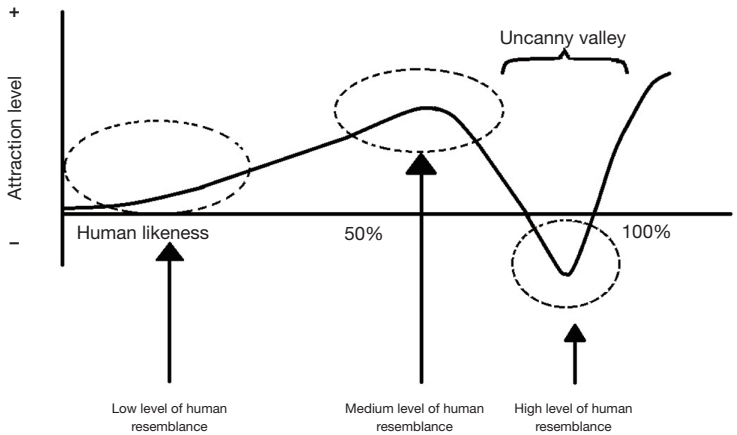

Figure 3 The uncanny valley effect (reproduced with permission from Sansoni *et al.* 2015). The more human-like appearance a robot has, the more familiar and pleasing to a viewer it seems (1st peak). This positive perception turns into unease and discomfort when the degree of the robot's human-likeness reaches a stage at which it is very close to being human, but not fully. This is the starting-point of a valley with low perceiver's affinity, the so-called uncanny valley, before the affinity starts increasing again (2nd peak) (2). To regain the same level of affinity after having escaped the valley, the robot must approach extremely high levels of human-likeness.

strange and disgusting than familiar (1). This is the starting-point of a valley with low perceiver's affinity, the so-called uncanny valley, before the affinity starts increasing again, forming a second peak (*Figure 3*) (2). To regain the same level of affinity after having escaped the valley, the robot must approach extremely high levels of human-likeness (approximately 100%).

Apart from robotics, the Uncanny Valley effect is well-known in the computer graphics community and is taken into consideration when generating characters in films, especially horror movies, with the goal to create figures that maximize the audience's fear. Freud, in an essay of 1955, was the first to admit his discomfort when seeing people with prosthetic limbs, which he attributed to an uncanny reaction. According to Mori's theory, this is because it falls to the valley: "*once we realize that the hand that looked real at first sight is actually artificial, we experience an eerie sensation. For example, we could be startled during a handshake by its limp boneless grip together with its texture and coldness. When this happens, we lose our sense of affinity, and the hand becomes uncanny.*" (1). To avoid falling in the valley, Mori suggests deliberately designing to a moderate degree of human likeness to minimize the risk of falling into the uncanny valley while still achieving a considerable sense of affinity.

Even though plastic surgery aims to restore form and function with as less deviation from the normal appearance as possible, this is not always feasible, due to a variety of reasons. In cosmetic surgery, the primary goal remains to avoid unnatural facial changes and surgical artifacts that could lead to what is referred to as "the operated-on" look (3). Choo *et al.*, introduced the uncanny valley's concept in the discipline of plastic surgery, hypothesizing that the phenomenon is observed when well-defined categories such as ethnicity, age, and gender are unconsciously violated in cosmetic procedures, i.e., creating a Westernized eyelid on an Asian patient to achieve a more Westernized look, but without considering the appearance of the face as a whole (3). We agree and believe that repeated plastic surgeries (e.g., multiple facelifts in celebrities) lead to uncanny outcomes which explain the unpleasant appearance.

However, in our experience, the uncanny valley effect is equally, if not more important in reconstructive surgery, i.e., reconstruction of extensive facial defects, e.g., after tumor resection. Not rarely, the defect size combined with the ablation of prominent anatomical structures (e.g., nose, mandible) make restoration to a normal appearance unrealistic. In such cases, when aiming for high human-likeness it is very easy to fall into the valley. Following Mori's suggestion, the reconstructive surgeon should act as a robot designer and appropriately aim for the first (humanoid) peak, instead of the second (real human) peak. In our experience, this is the most effective, satisfying and cost-effective approach for these patients to achieve both wound healing and social rehabilitation. We have dubbed this paradoxically pleasant final outcome from achieving only a moderately human-like appearance, without falling

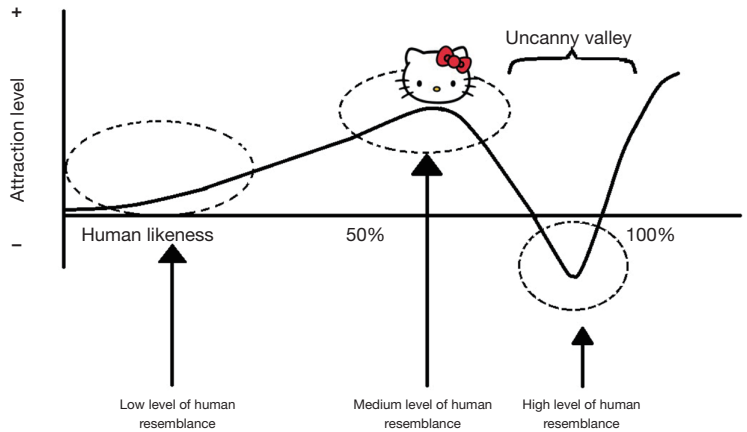

Figure 4 Modification of the uncanny valley graph to include the Hello Kitty effect. To avoid falling in the valley, Mori suggests deliberately designing to a moderate degree of human likeness to minimize the risk of falling into the uncanny valley, while still achieving a considerable sense of affinity. Hello Kitty is placed at the first peak, just before the valley, and is, therefore, intuitively considered pleasant and familiar. This explains its global perception of cuteness.

into the valley, the "Hello Kitty effect".

Hello Kitty, is a character introduced by Sanrio Co. Ltd., a company based in Japan, in 1974, with the aim to bring smiles to people's faces. Hello Kitty soon became one of the most recognizable characters worldwide. Its impact surpassed even the most optimistic company expectations (4). The success was so large that each year the character's products represented half of the company's sales, which rapidly expanded all around the globe. Europe, America, Latin America and other Asian countries soon embraced the character and Hello Kitty became a symbol of cuteness. The secret of Hello Kitty's success story remains a mystery. The character was designed as a white kitten, with two small black eyes, an orange nose and a pink bow on her left ear. No one can exactly explain what makes the character so cute, some even argue that Hello Kitty is not a cat but a girl. But there is one thing they all agree on: the lack of mouth (although unnatural, as mouth is a prominent factor for determining the emotional intent of a facial expression in both cats and girls) is not a drawback. In fact, it is not even noticeable.

How can a character without a mouth become the symbol of cuteness globally? The answer should be sought in the aforementioned uncanny valley theory. Hello Kitty hits the perfect mix of cat and human likeness. There are enough features to indicate she is a kitten and just enough human features to incite familiarity, but not so much she falls into the valley. If higher human resemblance had been sought, the character would have fallen into the valley. If less human resemblance had been achieved, the character would have been so kitten-like and possibly lost her relatability. Thus, Hello Kitty represents the peak before the uncanny valley (*Figure 4*).

The same principles apply to facial reconstruction, which should follow this less-is-more principle. High resemblance to normal appearance is desirable, but if not possible, lower resemblance rates can prevent falling into the valley of discomfort and negative perception. On the other hand, if the surgeon is too conservative, achieving too low degrees of human-likeness may also create a very unnatural appearance and a negative perception. Thus, less is more but not too less. Posch *et al.* found that in patients requiring double free-flaps the aesthetic outcome was scored more negatively by the independent investigator than the patients. The authors claim that "*the investigator was always looking for a completely normal appearance rather than just an improvement related to the severity of the defect or condition*" (5). Having too little human features, i.e., being too far from the first peak, will not sufficiently induce familiarity and still cause disgust; as in, we are too far from the first peak.

Indeed, the relationship between human-likeness and pleasant relatability is not linear, somewhat subjective, difficult to define, but undeniable. Approaching realistic human-likeness does not always induce favourable emotions, and compromising on certain features may still retain some form of cuteness. We conclude that the uncanny valley and the Hello Kitty effect should always be considered in patients with extensive facial defects to

assist surgeons customizing reconstructive goals to achieve the most pleasant (although not always realistic) outcome, pulling (instead of pushing) the limits of reconstruction.

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Footnote

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