



Supernormal stimuli

Description

A **supernormal stimulus** or **superstimulus** is an exaggerated version of a [stimulus](#) to which there is an existing response tendency, or any stimulus that elicits a response more strongly than the stimulus for which it evolved.

For example, when it comes to eggs, a bird can be made to prefer the artificial versions to their own,^[1] and humans can be similarly exploited by [junk food](#).^[2] The idea is that the elicited behaviours evolved for the “normal” stimuli of the ancestor’s natural environment, but the behaviours are now hijacked by the supernormal stimulus.

British academic [Nigel Spivey](#) demonstrates the effect in the first episode of the 2005 [BBC](#) documentary series [How Art Made the World](#) to illustrate neuroscientist [Vilayanur S. Ramachandran](#)’s speculation that this might be the reason for the grossly exaggerated body image demonstrated in works of art from the [Venus of Willendorf](#) right up to the present day.

In biology

In the 1950s, [Konrad Lorenz](#) observed that birds would select brooding eggs that resembled those of their own species but which were larger, and [Niko Tinbergen](#), following his extensive analysis of the stimulus features that elicited food-begging in the chick of the [herring gull](#), constructed an artificial stimulus consisting of a red knitting needle with three white bands painted around it; this elicited a stronger response than an accurate three-dimensional model of the parent’s head (white) and bill (yellow with a red spot).^[3]



Tinbergen and his students studied other variations of this effect. He experimented with dummy plaster eggs of various sizes and markings finding that most birds preferred ones with more exaggerated markings than their own, more saturated versions of their color, and a larger size than their own. Small songbirds which laid light blue grey-dappled eggs preferred to sit on a bright blue black polka-dotted dummy so large they slid off repeatedly. Territorial male stickleback fish would attack wooden floats with red undersides—attacking them more vigorously than invading male sticklebacks if the underside were redder.[1]

Lorenz and Tinbergen accounted for the supernormal stimulus effect in terms of the concept of the [innate releasing mechanism](#); however this concept is no longer widely used.[[citation needed](#)] The core observation that simple features of stimuli may be sufficient to trigger a complex response remains valid, however.

In 1979, the term supernormal stimulus was used by [Richard Dawkins](#) and [John Krebs](#) to refer to the exaggeration of pre-existing signs induced by social parasites, noting the manipulation of baby birds (hosts) from these, to illustrate the effectiveness of those signals.[4]

In 1983, entomologists Darryl Gwynne and David Rentz reported on the beetle [Julodimorpha bakewelli](#) attempting to copulate with discarded brown [stubbies](#) (a type of beer bottles) studded with tubercles (flattened glass beads).[5] This work won them the 2011 [Ig Nobel Prize](#) in biology.[6]

Another example of this is the study made by Mauck and colleagues, where they evaluated the effects of a plant pathogen named [cucumber mosaic virus](#) or CMV. This study showed that the aphids preferred the healthy plants but are still attracted by the infected plants, because of the manipulation of volatile compounds used by plants to attract them.[7]

Manipulation by parasites

In 2001, Holen et al., analyzed the evolutionary stability of hosts manipulation through exaggerated signals. Their model indicated that intensity of parasitic signals must be below a threshold to ensure acceptance from host. This threshold depends directly on the range of parasitism.[8]

For them, the only evolutionary stable strategy is when the host accepts all signs of the parasite with optimal intensity, which must be below the threshold; if this is not the case, the host can use these signals to identify the parasite.[8]

In psychology



Harvard psychologist [Deirdre Barrett](#) argues that supernormal stimulation govern the behavior of humans as powerfully as that of other animals. In her 2010 book, [Supernormal Stimuli: How Primal Urges Overran Their Evolutionary Purpose](#),^[9] she examines the impact of supernormal stimuli on the diversion of impulses for nurturing, sexuality, romance, territoriality, defense, and the entertainment industry's hijacking of our social instincts. In the earlier book, [Waistland](#),^[2] she explains [junk food](#) as an exaggerated stimulus to cravings for salt, sugar, and fats and [television](#) as an exaggeration of social cues of laughter, smiling faces and attention-grabbing action. Modern artifacts may activate instinctive responses which evolved prior to the modern world, where breast development was a sign of health and fertility in a prospective mate, and fat was a rare and vital nutrient.

In a cross-cultural study, Doyle and Pazhoohi showed that surgically augmented breasts are supernormal stimuli, and they are more attractive than natural breasts, regardless of their size.^[10] Also in a theoretical paper, Doyle proposed that how women walk creates supernormal stimuli through continuously alternating motion of the waist and hips causing peak shifts in perceptions of physical attractiveness involving women's [waist-to-hip ratio](#).^[11]

In art

Costa and Corazza (2006),^[12] examining 776 artistic portraits covering the whole history of art, showed that eye roundness, lip roundness, eye height, eye width, and lip height were significantly enhanced in artistic portraits compared to photographic ones matched for sex and age. In a second study, forty-two art academy students were requested to draw two self-portraits, one with a mirror and one without (from memory). Eye and lip size and roundness were greater in artistic self-portraits. These results show that the exaggeration and "supernormalization" of key features linked to attractiveness, such as eye and lip size, are frequently found in art.

See also

- [Hyperreality](#), a similar concept in [semiotics](#)
- [Peak shift principle](#)

en.wikipedia.org/wiki/Supernormal_stimulus



Further References

Antenucci, R. G., & Hayes, J. E.. (2015). Nonnutritive sweeteners are not supernormal stimuli. *International Journal of Obesity*



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"Background: it is often claimed that non-nutritive sweeteners (nns) are 'sweeter than sugar', with the implicit implication high potency sweeteners are super-normal stimuli that encourage exaggerated responses. this study aimed to investigate the perceived sweetness intensity of a variety of nutritive (sucrose, maple syrup, and agave nectar) and nns (acesulfame-k (acek), rebaudioside a (reba), aspartame, and sucralose) in a large cohort of untrained participants using contemporary psychophysical methods. methods: participants (n=401 total) rated the intensity of sweet, bitter, and metallic sensations for nutritive and nns in water using the general labeled magnitude scale (glms). results: sigmoidal dose-response functions were observed for all stimuli except acek. that is, sucrose follows a sigmoidal function if the data are not artifactually linearized via prior training. more critically, there is no evidence that nns have a maximal sweetness (intensity) greater than sucrose; indeed, the maximal sweetness for acek, reba and sucralose were significantly lower than for concentrated sucrose. for these sweeteners, mixture suppression due to endogenous dose-dependent bitter or metallic sensations appears to limit maximal perceived sweetness. conclusions: in terms of perceived sweetness, non-nutritive sweeteners cannot be considered super-normal stimuli. these data do not support the view that non-nutritive sweeteners hijack or over-stimulate sweet receptors to product elevated sweet sensations. international journal of obesity accepted article preview online, 19 june 2014; doi:10.1038/ijo.2014.109."

Christy, J. H.. (2002). Mimicry, Mate Choice, and the Sensory Trap Hypothesis. The American Naturalist

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"Sensory traps affect mate choice when male courtship signals mimic stimuli to which females respond in other contexts and elicit female behavior that increases male fertilization rates. because of the supernormal stimulus effect, mimetic signals may become quantitatively exaggerated relative to model stimuli. viability selection or a decrease in responsiveness to signals that are exaggerated beyond their peak supernormal effect may limit signal elaboration. females always benefit by responding to models and they may often benefit by responding to mimetic courtship signals. if the response as a preference is costly, it may be maintained by frequent and strong selection for the response to the model. i review five examples of courtship that illustrate the kinds of studies that can provide evidence of sensory traps. the strategic designs of mimetic courtship signals arise not from selection of responses to them but from selection for responses to models. this results from deceit by mimicry and the evolution of sensory trap responses before the signals that elicit them as preferences."

Morris, P. H., White, J., Morrison, E. R., & Fisher, K.. (2013). High heels as supernormal stimuli: How wearing high heels affects judgements of female attractiveness.



Evolution and Human Behavior

Plain numerical DOI: 10.1016/j.evolhumbehav.2012.11.006

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“There is a strong contemporary association between high heels and female sexuality. we investigated the hypothesis that one motivation for women wearing high heels is that it artificially increases the femininity of gait. we isolated the effects of heels on gait using point-light methodology. females were recorded walking in flat shoes and high heels. participants viewed point-light videos of the women wearing the two types of shoe. participants judged the females in the heels condition as significantly more attractive (with a large effect size) than the females in the flat shoe condition. biomechanical analyses revealed that wearing high heels led to increased femininity of gait including reduced stride length and increased rotation and tilt of the hips. we conclude that high heels exaggerate sex specific aspects of female gait and women walking in high heels could be regarded as a supernormal stimulus. © 2013 elsevier inc.”

Tanaka, K. D., Morimoto, G., Stevens, M., & Ueda, K.. (2011). Rethinking visual supernormal stimuli in cuckoos: Visual modeling of host and parasite signals. *Behavioral Ecology*

Plain numerical DOI: 10.1093/beheco/arr084

[DOI URL](#)

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“Some parasitic cuckoo chicks display a vivid-colored gape to their host parents when begging for food. their mouth color was once regarded as a supernormal stimulus, yet owing to a lack of experimental support, the idea has fallen out of favor. however, previous experiments were conducted without considering the vision of avian receivers. we compared the color and visibility of begging signals between chicks of a brood parasite, the horsfield’s hawk-cuckoo (*cuculus fugax*), and that of its host, the red-flanked bluetail (*tarsiger cyanurus*), considering bird vision. we investigated the mouth palate of host and parasite chicks, and a gape-colored skin patch on the wing of parasite chicks, which has previously been demonstrated to induce host parental feeding. we found that, in terms of stimulation of the birds’ photoreceptors and visual discrimination thresholds, visibility of parasite signals, particularly of the wing-patch, was quantitatively greater than that of the host chick signal. meanwhile, host and parasite signals were qualitatively different in the hue, which was driven mostly by greater ultraviolet reflectance of the parasite signals. evidence from previous studies indicates that the visual attributes of the parasite signals may induce parental provisioning, suggesting that signal exaggeration of the parasite has evolved to stimulate hosts effectively in the dark nest environment. overall, our results suggest that the color of hawk-cuckoo chicks’ signaling traits can work as a supernormal stimulus, although host parental responses to exaggerated stimuli need to be tested experimentally.”

Staddon, J. E. R.. (2002). A Note on the Evolutionary Significance of “Supernormal” Stimuli. *The American Naturalist*

Plain numerical DOI: 10.1086/283025

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“Animals often respond more strongly to extreme (supernormal) stimuli, never encountered in nature, than to the natural stimulus: birds preferentially retrieve extra-large or extra-speckled eggs, for example. an analogous phenomenon in discrimination learning, the ‘peak shift,’ suggests that many instances of supernormality may reflect the action of two factors during phylogeny: (a) asymmetrical selection pressure with respect to responsiveness to the relevant stimulus continuum (e.g., size, speckledness), and (b) independent selection pressures limiting the corresponding properties of the natural stimulus.”

Costa, M., & Corazza, L.. (2006). Aesthetic phenomena as supernormal stimuli: The case of eye, lip, and lower-face size and roundness in artistic portraits. *Perception*

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“In the first study, eye and lip size and roundness, and lower-face roundness were compared between a control sample of 289 photographic portraits and an experimental sample of 776 artistic portraits covering the whole period of the history of art. results showed that eye roundness, lip roundness, eye height, eye width, and lip height were significantly enhanced in artistic portraits compared to photographic ones. lip width and lower-face roundness, on the contrary, were less prominent in artistic than in photographic portraits. in a second study, forty-two art academy students were requested to draw two self-portraits, one with a mirror and one without (from memory). eye, lip, and lower-face roundness in artistic self-portraits was compared to the same features derived from photographic portraits of the participants. the results obtained confirmed those found in the first study. eye and lip size and roundness were greater in artistic self-portraits, while lower-face roundness was significantly reduced. the same degree of modification was found also when a mirror was available to the subjects. in a third study the effect of lower-face roundness on the perception of attractiveness was assessed: fifty-three participants had to adjust the face width of 24 photographic portraits in order to achieve the highest level of attractiveness. participants contracted the face width by a mean value of 5.26%, showing a preference for a reduced lower-face roundness. all results are discussed in terms of the importance of the ‘supernormalisation’ process as a means of assigning aesthetic value to perceptual stimuli.”

Goodwin, B. C., Browne, M., & Rockloff, M.. (2015). Measuring Preference for Supernormal Over Natural Rewards: A Two-Dimensional Anticipatory Pleasure Scale. *Evolutionary Psychology*

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“Supernormal (sn) stimuli are artificial products that activate reward pathways and approach behavior more so than naturally occurring stimuli for which these systems were intended. many modern consumer products (e.g., snack foods, alcohol, and pornography) appear to incorporate sn features, leading to excessive consumption, in preference to naturally occurring alternatives. no measure currently exists for the self-report assessment of individual differences or changes in susceptibility to such stimuli. therefore, an anticipatory pleasure scale was modified to include items that represented both sn and natural (n) classes of rewarding stimuli. exploratory factor



analysis yielded a two-factor solution, and as predicted, n and sn items reliably loaded on separate dimensions. internal reliability for the two scales was high, $\alpha = .93$ and $\alpha = .90$, respectively. the two-dimensional measure was evaluated via regression using the n and sn scale means as predictors and self-reports of daily consumption of 21 products..."

Category

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