Department of Health Science and Technology

Consumer acceptance of novel foods & food technologies

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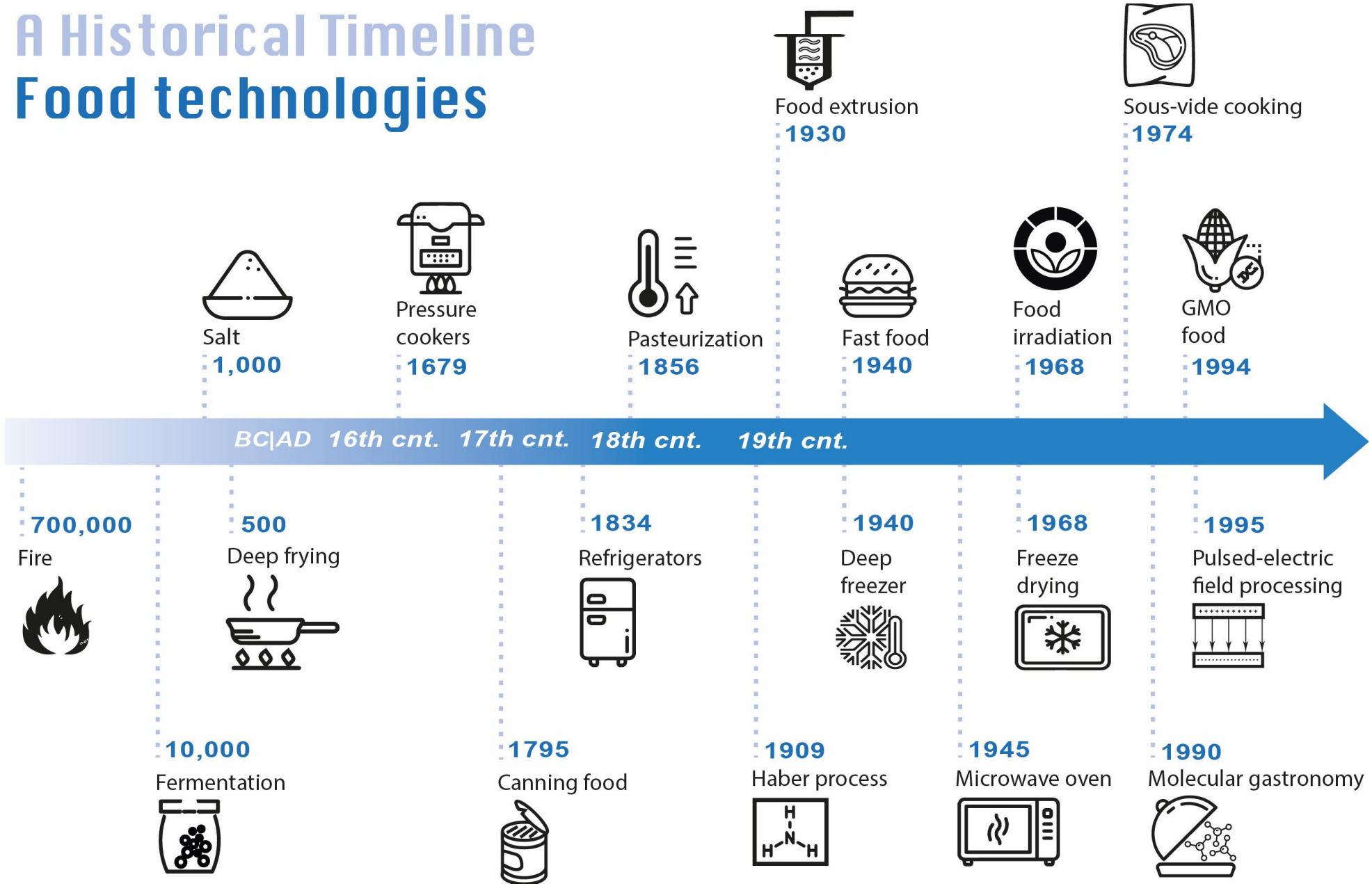
Consumer Behavior
Parma Summer School 2021

A Historical Timeline
Food technologies

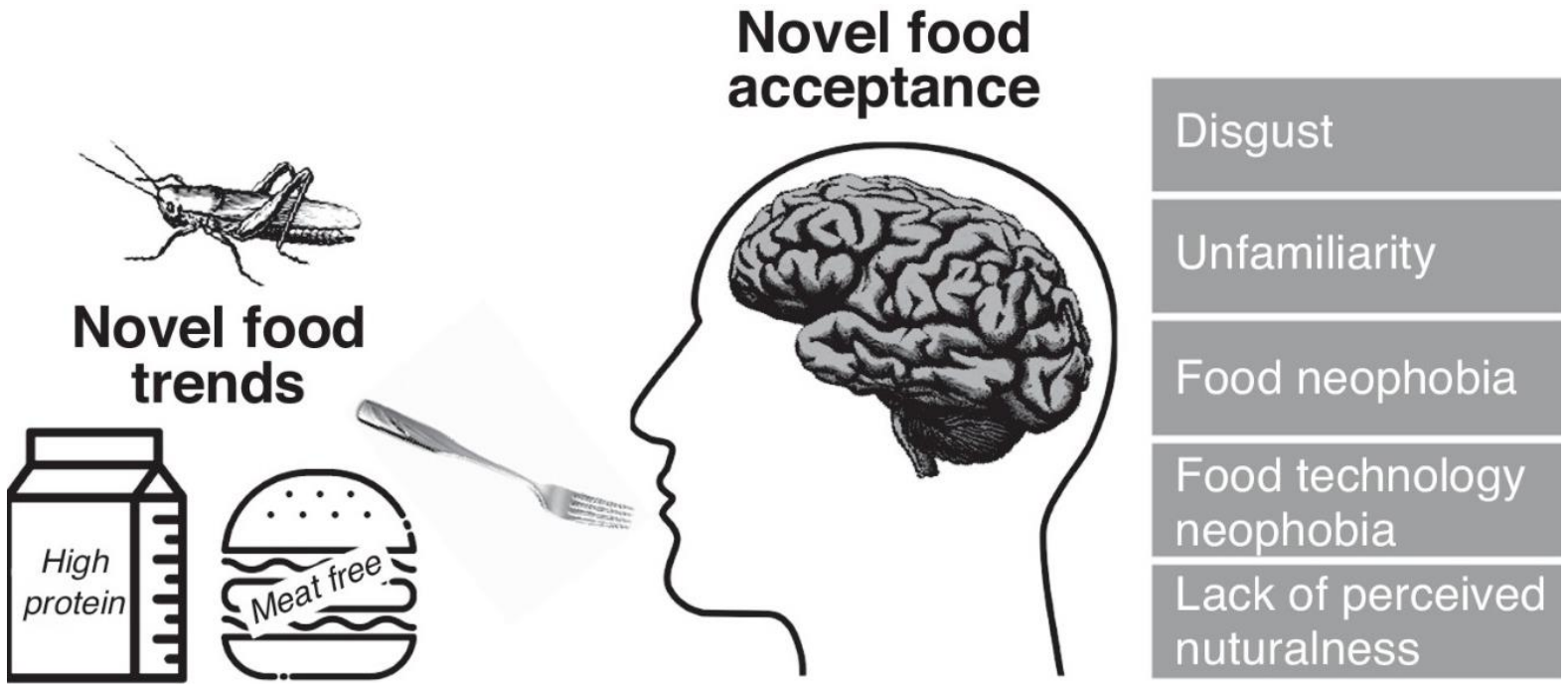


(Siegrist & Hartmann, 2020)

How consumers process novelty – the power of familiarity and expectations

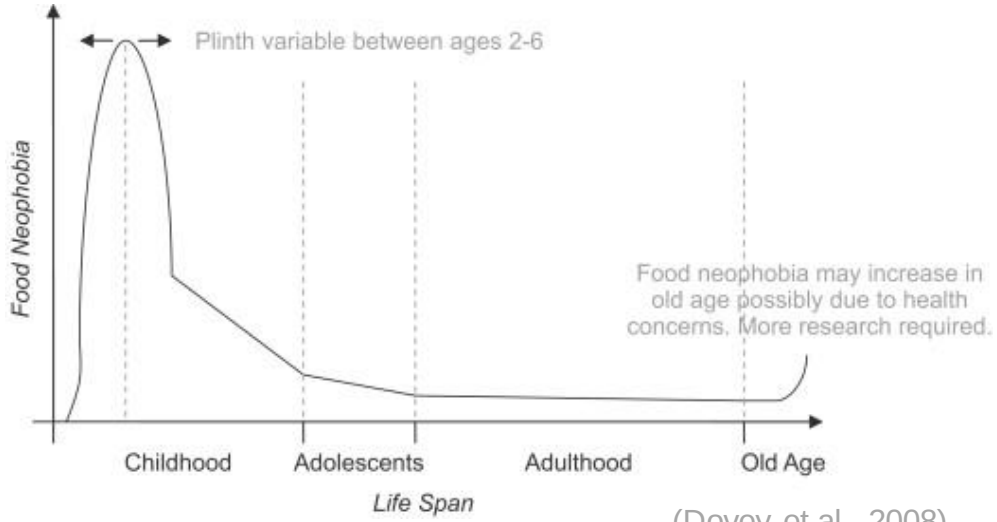
- Novel foods and unfamiliar foods
- Familiarity brings certainty about the food and reduced anxiety and suspicion
- Familiar products are usually better liked
- Exposure is the main building block of familiarity, while knowledge comes as second factor
- Perceived sensory quality (appearance, texture, chemosensory attributes) is the corner stone of acceptance

Disposition and traits that shape responses to novel foods



Tuorila, H., & Hartmann, C. (2020). Consumer responses to novel and unfamiliar foods. *Current Opinion in Food Science*, 33, 1-8.

Disposition and traits that shape responses to novel foods

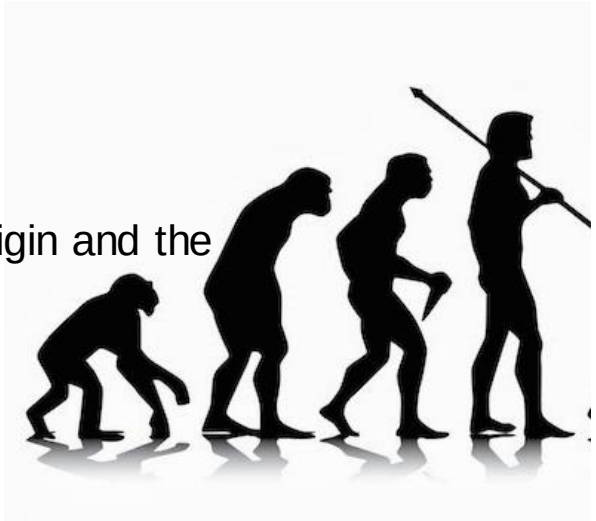


(Dovey et al., 2008)

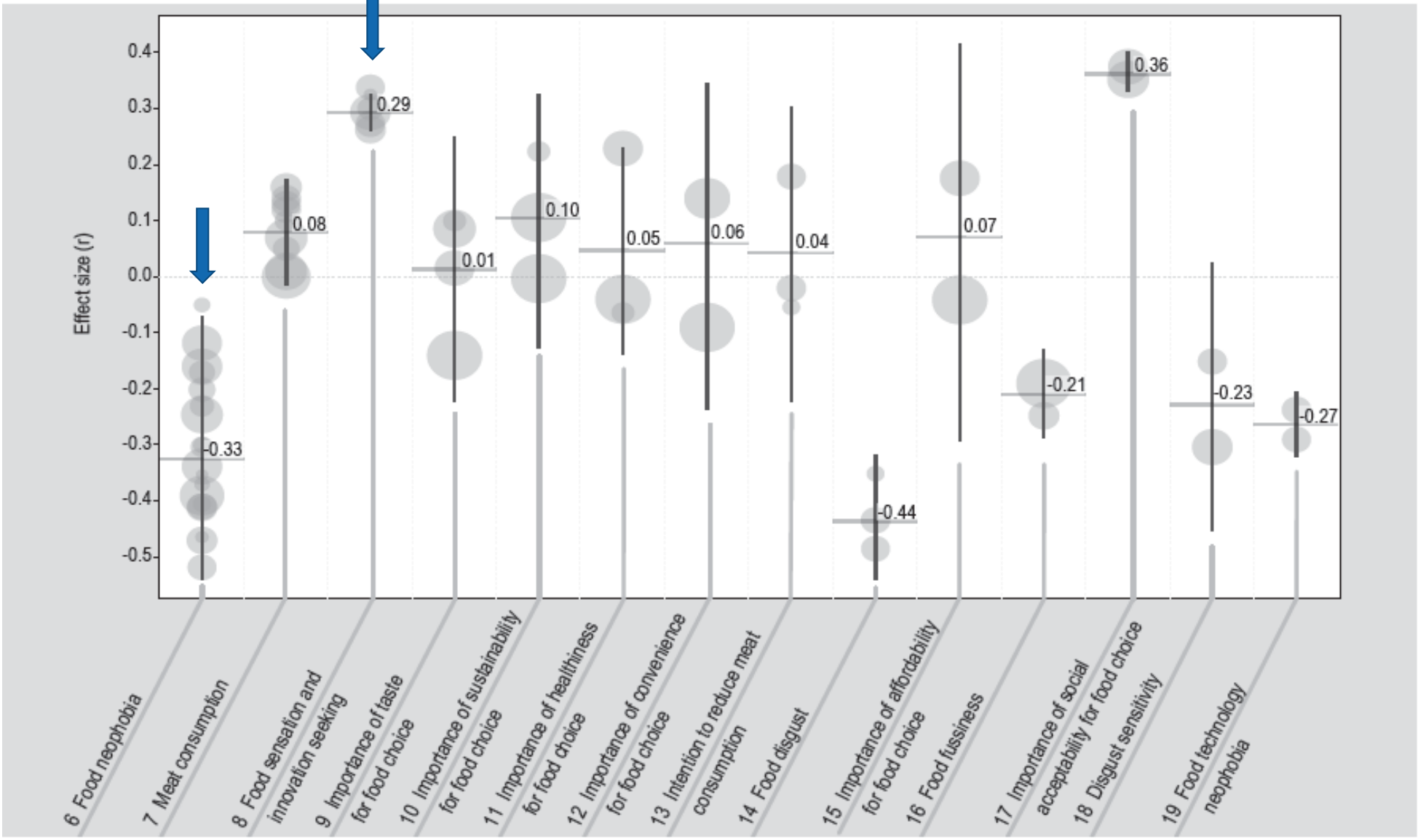
Food neophobia

- Unwillingness to eat new, unfamiliar foods
  - Evolutionarily beneficial survival mechanism (internal gatekeeper)
  - Ambivalent reaction towards new foods: avoidance to ingest noxious or toxic chemicals (e.g., poisonous plants) vs. search for new food sources ('Omnivore's dilemma')
  - Naturally starts in early childhood; decreases with age through positive food experiences

- Food Neophobia Scale (Pliner & Hobden, 1992): reaction to ethnic and other 'culture' foods
  - Associated with decreased levels of willingness to eat a novel (unfamiliar) food
  - Negative taste expectations, low levels of expected enjoyment, uncertainty about the origin and the attributes of the product, disgust, dangerousness
  - Negative correlate: variety seeking



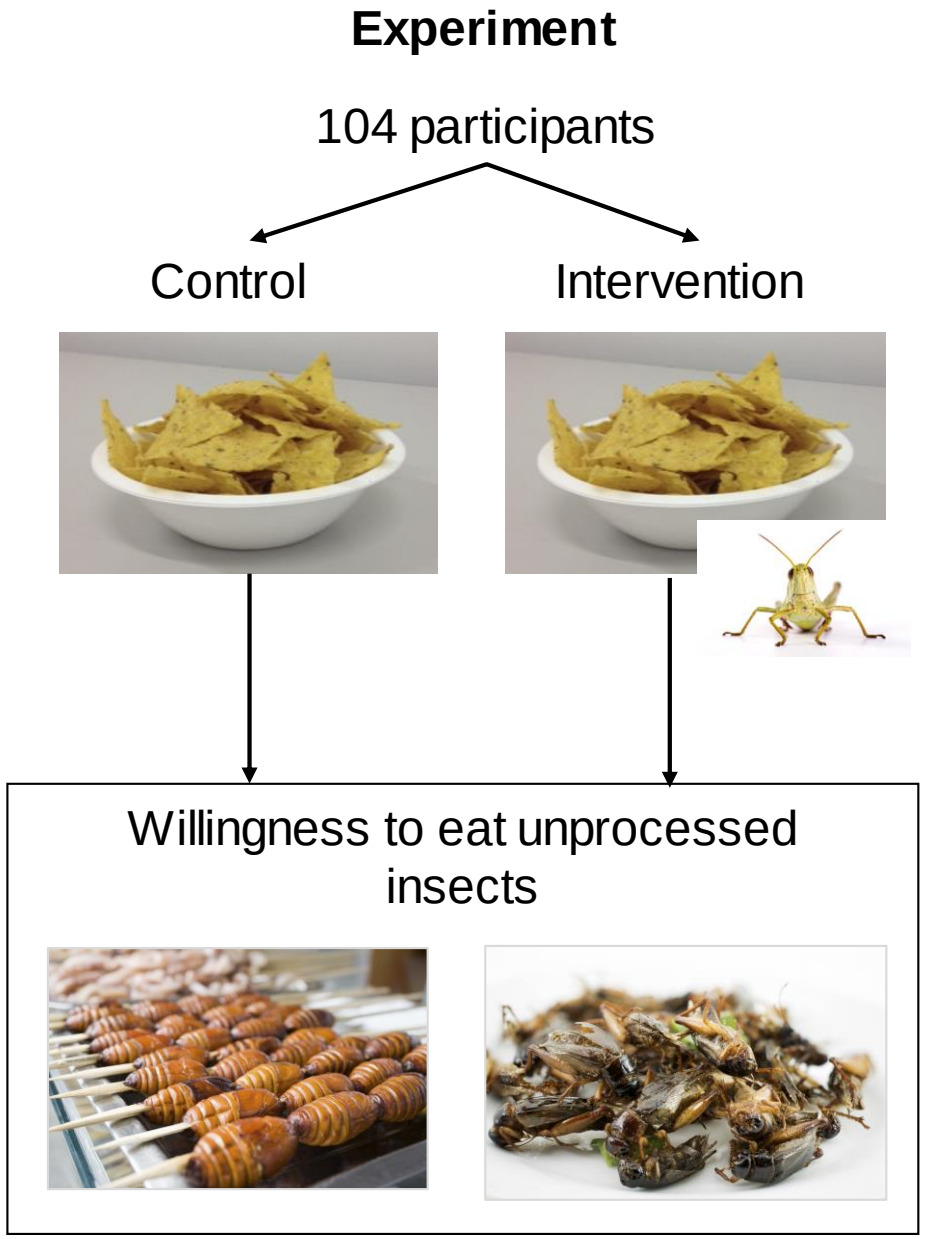
Forest plot of the willingness to consume insects correlates



(Wassmann, Siegrist & Hartmann, 2021)

Overcoming rejection

- Increasing familiarity, positive eating experiences, possibilities to explore, visibility & access
- Communicating benefits
- Combination with known foods & flavours, processing (Deroy et al., 2015, Schosler et al., 2012, Caparros Megido et al., 2014),
- Naming and description of product without technical terms or contamination associations provoking (Deroy et al., 2015, Egolf et al., 2019)



(Hartmann & Siegrist, 2016)

Disposition and traits that shape responses to novel foods

Food technology neophobia (FTNS)

- Fear of food technologies
- Measure of attitudes towards new food technologies
  (Cox & Evans, 2008)
  (1) new food technologies are unnecessary (New food technologies *decrease* the natural quality of food)
  (2) perception of risk (New food technologies may have long term *negative* environmental effects)
  (3) healthy choices (New products using new food technologies can help people have a balanced diet)
  (4) information (The media usually provides a *balanced* and *unbiased* view of new food technologies)
- Correlation with food neophobia (between -0.12 to 0.33 in different populations)

Willingness to try

Technology	Mean FTNS
Pasteurisation	–0.29**
Selective breeding	–0.20*
Fortification	–0.39**
Bioactives	–0.29**
Triploidy	–0.44**
Genetic modification	–0.58**
Nanotechnology	–0.39**

**p<.01

(Evans et al., 2010)

Disposition and traits that shape responses to novel foods

Disgust

- First line of defence at expected pathogen presence, cultural inappropriate food, body fluids, etc.
- Avoidance of the stimuli (food rejection, nausea & vomiting)
- Disgust cues (slimy, smelly, human contamination, animalness, moral violations)
- Decreases likelihood of incorporation of toxic substances & infections

Disgust sensitivity

- People vary in disgust proneness, which influences perception of disgustingness
- Linked to food behavior (e.g., picky eating, texture rejection, food waste behavior, kitchen hygiene)

  → Functional and dysfunctional effects
- Food disgust sensitivity & contamination sensitivity

When evolution works against the future

Online survey

- German-speaking Swiss consumers
- N=313, age 45 years, 51% female
- Description of food technologies
- Acceptance, perceived risk & benefit, disgust towards 7 food technologies
- Individual factors

Food technologies

- *GM meat*
- *GM fish*
- *Nanotechnology food box & coating film*
- *Artificial meat & milk*
- *Synthetic produced food additive*

Table I. Information Regarding New Food Technology Applications Provided to Participants

New Food Technology Application	Description
GM meat (pork)	Gene technology offers the possibility to produce pork meat that contains healthy omega-3 fatty acids. To do so, a gene that enables production of omega-3 fatty acids is transferred from a roundworm into the pig genome, and thereby, the pig can produce omega-3 fatty acids rather than just unhealthy omega-6 fatty acids.
GM fish	Fish can be genetically modified to increase their resistance against diseases by inserting a human lactoferrin gene. Lactoferrin is an enzyme with antiviral and antimicrobial properties.
Edible nanotechnology coating film	By using nanotechnology, edible coatings for food can be produced that have a thickness of just 5 nm and are not visually detectible. These thin edible films can be used to package, for example, meat, to prevent moisture loss, and thus prolong shelf life. Negative impacts of nanoparticles on health and the environment are still not well understood.
Nanotechnology food box[a]	In nanotechnology food packaging, food boxes with small nanoparticles were developed. Small silver particles in plastic boxes prevent bacterial growth. The main advantage is longer product shelf life. Next to its benefits, this nanotechnology also poses some dangers. Experts are uncertain about whether the silver particles might migrate from the packaging material into the food. Negative impacts on health and the environment are still not well understood.
Artificial meat[b]	Red meat such as beef can be produced through tissue cultivation. To do so, a few cells are obtained from the muscle tissue of cows. These cells are artificially grown and develop into muscle cells. This production method is more environmentally friendly and associated with less animal suffering compared to conventional meat production. The taste of meat produced by tissue cultivation is comparable to conventionally produced meat.
Artificial milk	Basically, milk consists of water, several milk proteins, and fats. To make artificial milk, the DNA sequences of the different milk proteins are constructed and inserted into yeast. The yeast then produces milk proteins. By adding water and aromatic fatty acids, the artificial milk is finished. The artificial milk tastes similar to cow's milk and results in less CO_2 emissions than the traditional milk production. The artificial milk can also be produced lactose-free.
Synthetically produced food additive (citric acid)	Beverages (e.g., lemonades) often include synthetically produced citric acid (E330) as a preservative. The citric acid is produced by specific mold cultures (*Aspergillus niger*).

[a]Description adapted from Siegrist et al. (2007).
[b]Description adapted from Siegrist et al. (2018).
GM, genetically modified.

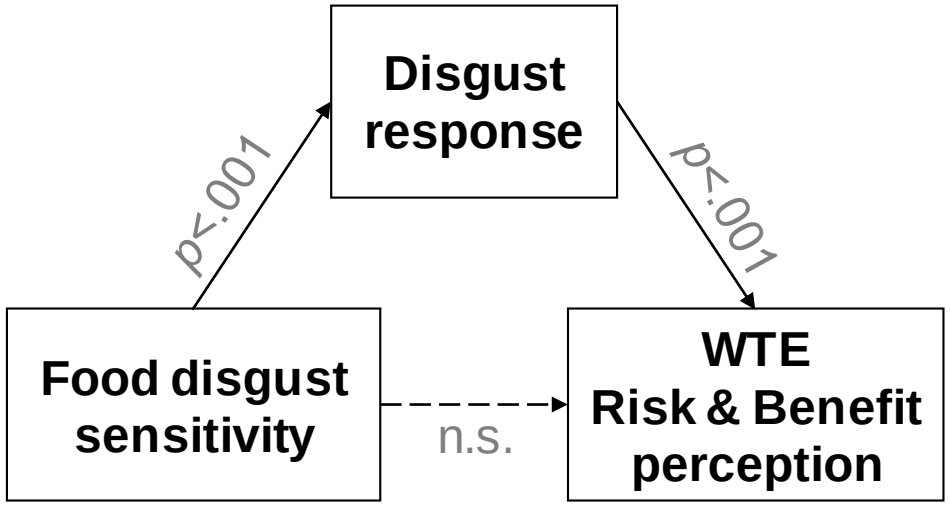
(Egolf et. al, 2019)

When evolution works against the future

Results

- Some technologies evoked a stronger disgust response, were evaluated to be less beneficial and riskier than others (e.g. GM)

- The higher trait food disgust, the higher state disgust, the lower acceptance (full mediation)



Discussion

- With insufficient knowledge, people rely on **heuristics**

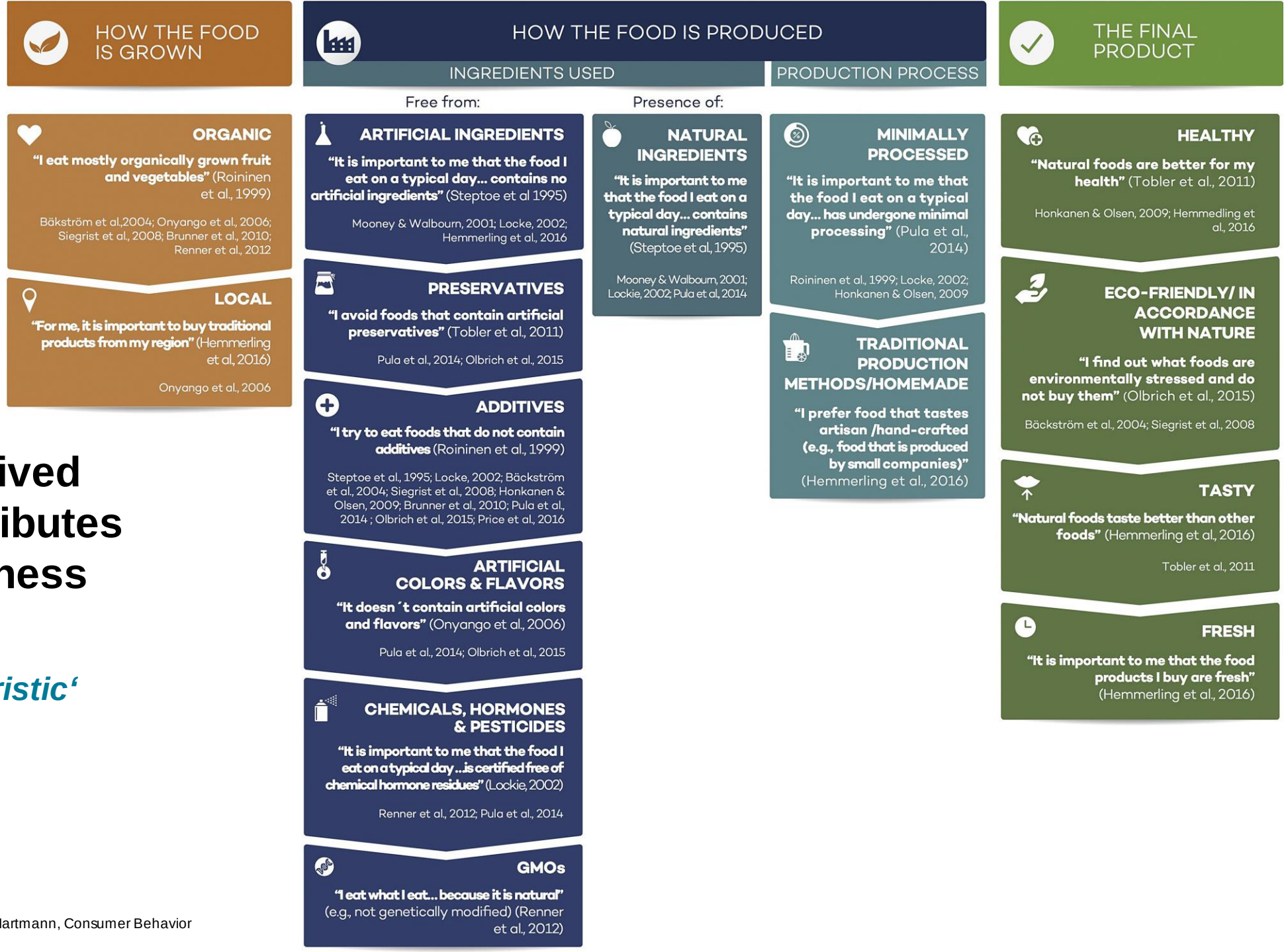
- **Feelings** associated with a new technology influence risk and benefit perception and acceptance of new food technologies → affect heuristic

- **Provoking cues** can be links to 'animalness', contamination, human tempering with nature, technological descriptions/unnaturalness …

Consumers perceived importance of attributes indicating naturalness

(Roman et al., 2017)

‚Natural-is-better heuristic‘



Perceived naturalness and acceptance of cultured meat

Online survey

- 204 Swiss consumer, convenience sample, av. 60 years, 43% women
- Experimental manipulation: information about organic vs. in vitro meat
- Influence on naturalness perception meat
- Influence on WTC

Information provided in the two conditions

Beef from organic production, such as ground beef, is more environment-friendly and associated with less animal suffering compared with beef from traditional meat production.

Consumption of organic ground beef is comparable with consumption of ground beef from traditional meat production, also with regard to taste.

In vitro meat is produced by means of biotechnology. In doing so, red meat such as ground beef is produced in the laboratory. This production method is more environment-friendly and associated with less animal suffering compared with traditional meat production.

Consumption of in vitro ground beef is comparable with consumption of ground beef from traditional meat production, also with regard to taste.

(Siegrist et al., 2018)

Perceived naturalness and acceptance of cultured meat

Results

- Organic meat was considered more natural and received higher WTC
- Naturalness perception fully mediated the WTC the meat
- Paradoxical effect: information about cultured meat made traditional meat appear more acceptable

Discussion

- Lack of naturalness important reason
- Naming and description is key (technical terms vs. non-technical terms)

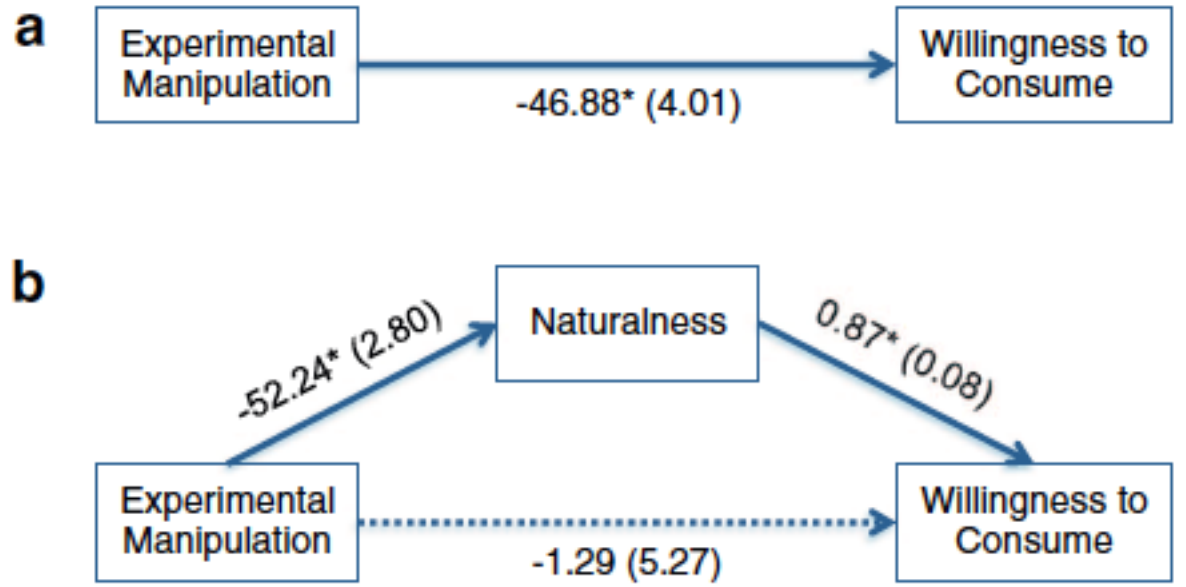


Fig. 1. Results of the mediation analysis for the impact of the meat production method (organic vs. in vitro method) on the perceived willingness to consume ground meat. The production method variable (i.e., experimental manipulation) was dummy coded (0 = organic method, 1 = in vitro method). Fig. 1a shows the total effect of experimental manipulation on the willingness to consume the meat without the mediator variable. Fig. 1b shows the model with the perceived naturalness of the meat as the mediator variable. Nonstandardized coefficients (SEs) are presented and can be interpreted in a similar way as regression coefficients. Nonsignificant paths are depicted as dotted lines. Note: $^{*}p < 0.001$.

(Siegrist et al., 2018)

Table 1

Potential drivers of acceptance or rejection of novel and unfamiliar foods. The list illustrates the multitude of new products and motivations, but it is not exclusive

Type of food	Definition	Acceptance	Rejection
Ethnic	Unfamiliar locally, known and 'safety tested' in another culture	Variety seeking Increased availability	Unfamiliar (weird) sensory properties Uncertainty Food neophobia
Nutritionally modified	Contains often more fiber or less fat, sodium, or sucrose than a conventional food	Health, nutrition and well-being	Sensory properties may differ from regular
Functional	Evidence based beneficial effect due to special ingredients	Health, nutrition and well-being	Price Perceived uselessness
Free from	An ingredient unfit for a part of population has been omitted (e.g., lactose, gluten, palm oil)	The absence of unhealthy or unfit ingredient	Sensory properties may differ from regular
Vegetarian and vegan	Free from meat and other animal-based material (different levels exist, fully free = vegan)	Meat avoidance Environmental concerns Moral views Health, nutrition and wellbeing Ethical value	Attached to meat Perceived inadequacy of nutritional value
Organic	Produced in traditional farming conditions without fertilizers or herbicides/pesticides	Naturalness Health, nutrition and well-being Ethical value	Price Quality defects
Plant based meat replacers	Products replacing the meat component from a dish or meal	Source of protein Ethical value	Attached to meat Sensory expectations hard to meet
Insect	Product containing whole or bruised insects	Source of protein Curiosity	Disgust Food neophobia
Artificial meat	Meat produced from stem cells without a living animal body	Sensory properties similar to meat Ethical value	Disgust Unnaturalness
Genetically modified (GMO)	Contains, consists of, or produced from genetically modified material	Price Improved quality	Unnaturalness Food technology neophobia
3D-printed	Computer-assisted design combined with 3D food printer -> products in complex patterns and shapes	Personalized nutrition	Disgust Unnaturalness Food technology neophobia

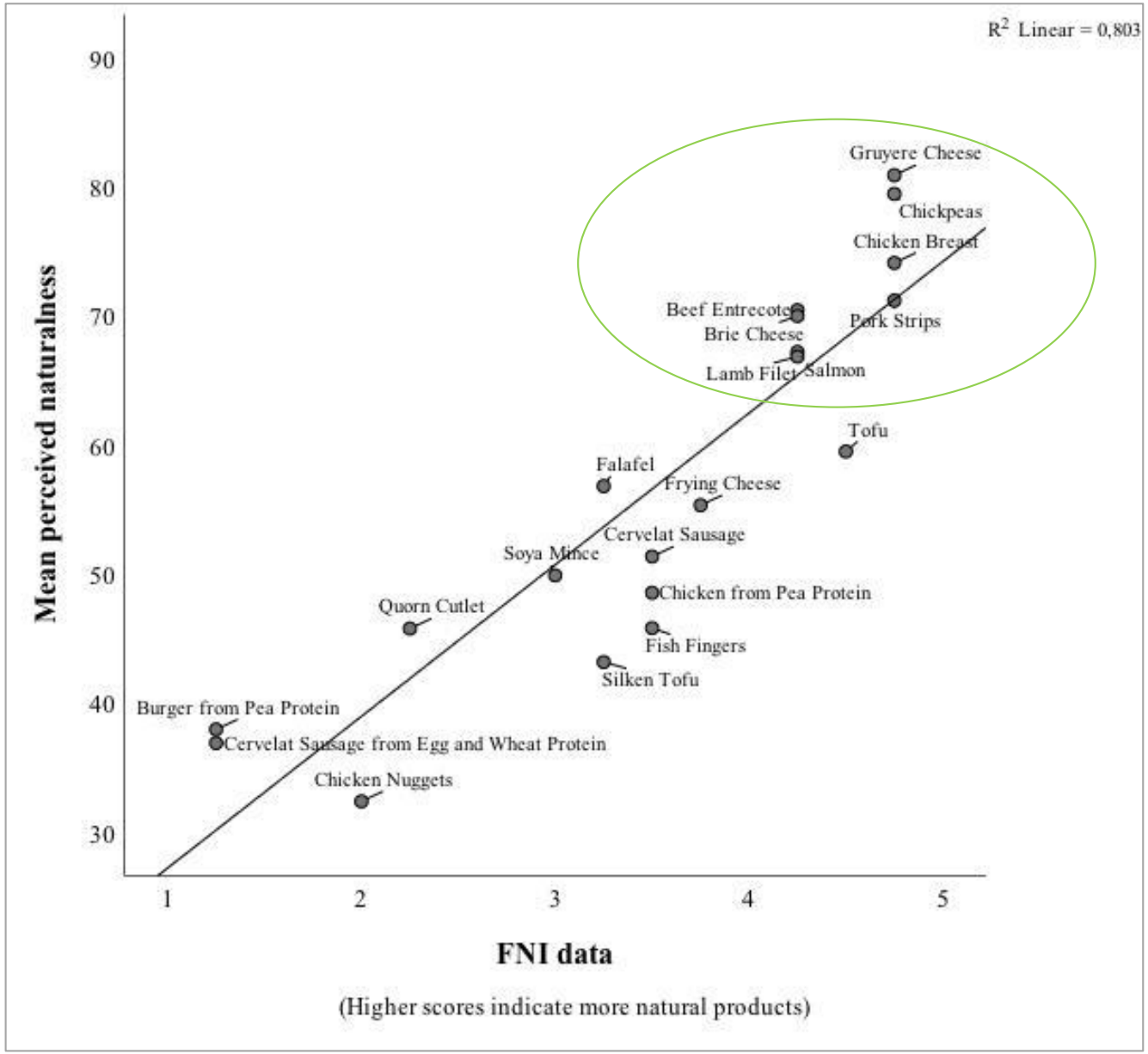
(Tuorila & Hartmann, 2020)

Comparison meat vs. meat alternatives

Natural-is-better heuristic

Evaluation of meat alternatives

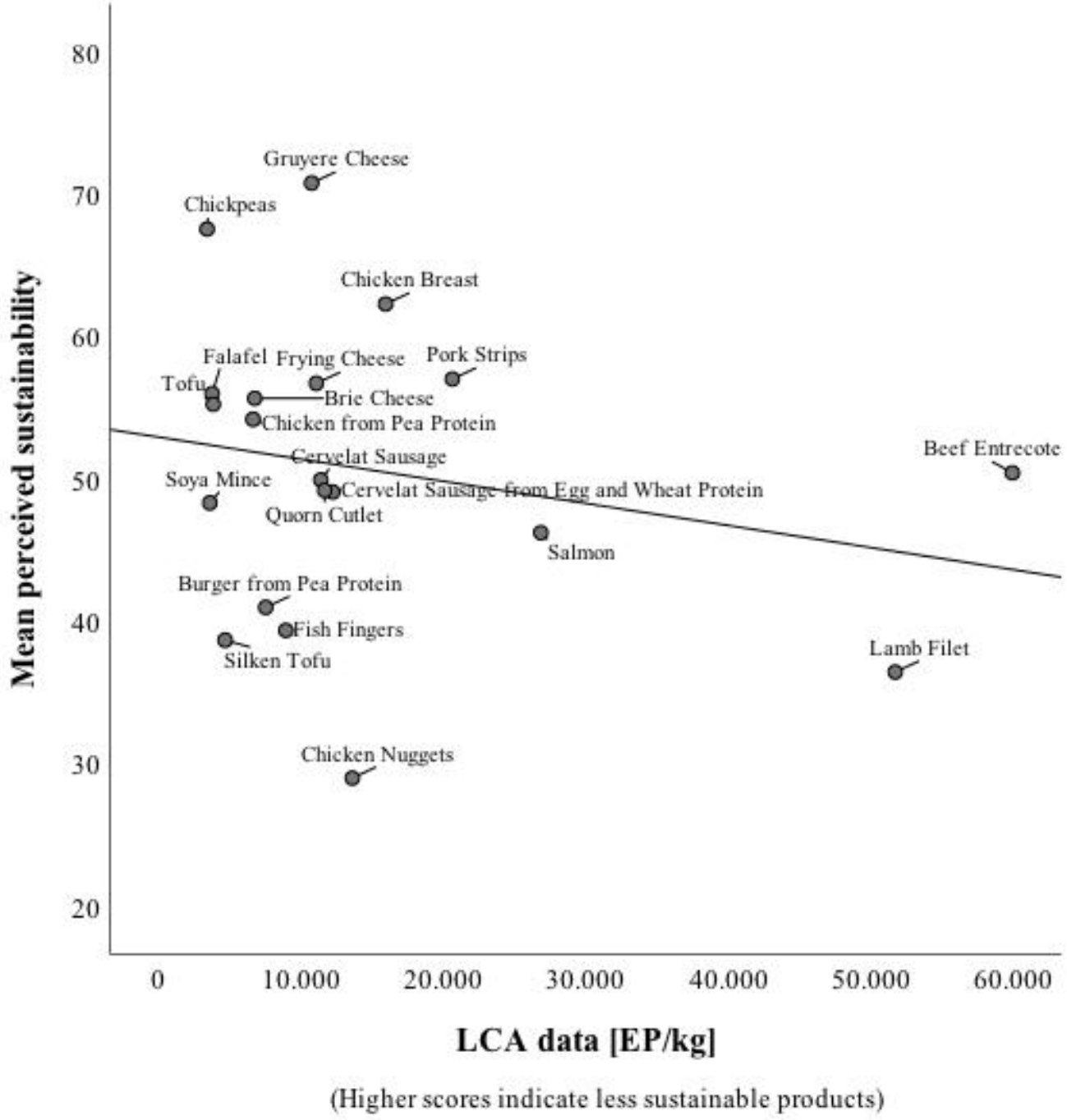
- FNI (food naturalness index) considers additives, farming practice, degree of processing and unexpected ingredients – consumer driven (Sanchez-Siles et al., 2019)



Hartmann, Furthwängler & Siegrist, (in prep)

Perceived sustainability

- No significant correlation between perceived and objective environmental friendliness (LCA data)
- Pork stripes, chicken breast, cervelat were perceived as more sustainably than alternatives such as silken tofu, pea protein burger, soya, quorn
- **Uncertainty/misconceptions regarding environmental friendliness**



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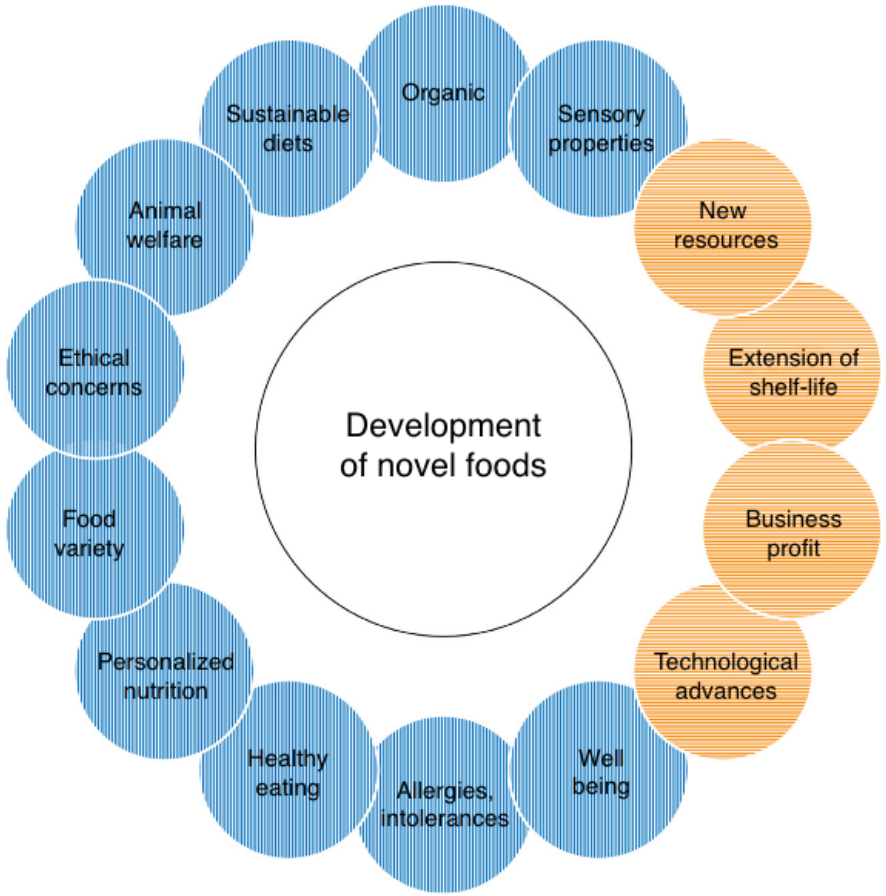
Conclusion



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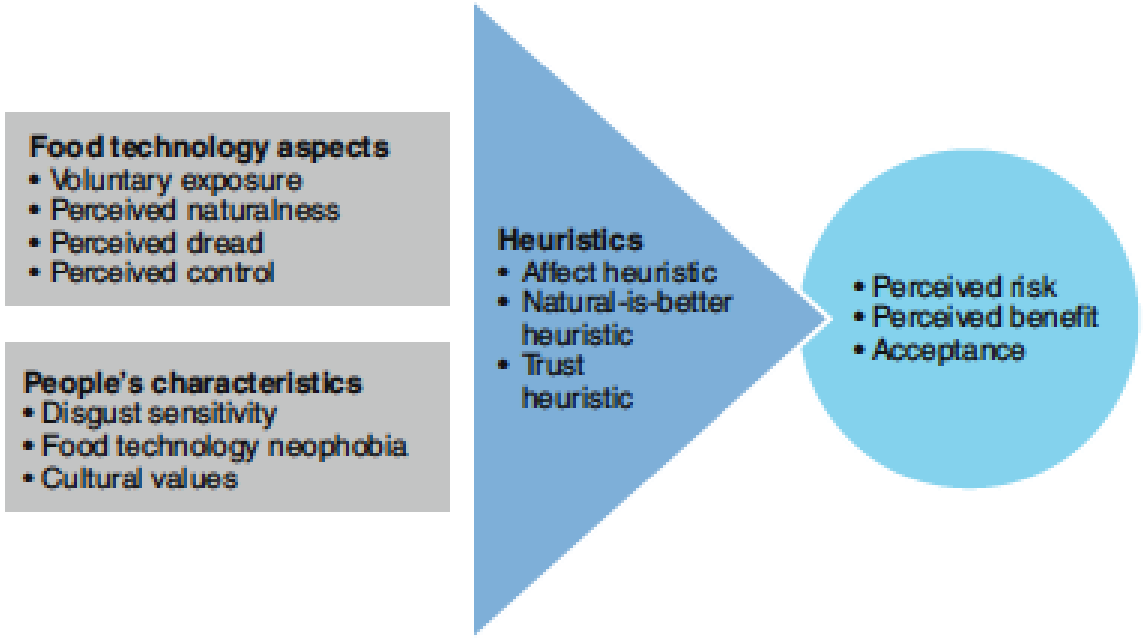

Fig. 2 | Factors influencing the perception of food technologies. How a food technology is perceived by consumers depends both on the perceived aspects of a food technology and on the individual characteristics of the consumers. Furthermore, both of these factors influence the heuristics that consumers rely on when evaluating the benefits, risks and acceptance of food technologies.

(Siegrist & Hartmann, 2020)

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