ÖAW Winterschool

Tracing the Evolution of Emotion Studies in Psychology and Sentiment Analysis

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The classical view on emotions

"Emotions are patterns of physiological activity and conscious experience that are associated with natural objects, events, or situations."

Paul Ekman, Emotions Revealed: Understanding Faces and Feelings, 2003

Classical view on emotions
informs state of the art sentiment analysis

Each feeling has a distinct emotional fingerprint

because they activate identical reactions in the brain

that translates in facial expressions that are universal and are understood everywhere

and are related to identical reactions.

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A classical view of emotions for state of the Art NLP

Definition of the Classical View of Emotions (Paul Ekman, first published in 1972):

- **Emotions are fixed, universal, and biologically determined responses to specific situations.**
- In the context of sentiment analysis and emotion detection in computer science, especially in the realm of recommender systems, current methods which rely on pre-defined sets of basic emotions or sentiment labels may not be able to capture the complexity and variability of emotional experience.

“Except ... she is not. This is actually a triumphant Serena Williams after she beat her sister, Venus, in the 2008 U.S. Open tennis finals (see Appendix, for the full photograph). When viewed in context, Ms. Williams’s configuration of facial muscles instantly takes on a different emotional meaning.” Barret, 2022, p. 895

Source: Barrett, L. F. (2022). Context reconsidered: Complex signal ensembles, relational meaning, and population thinking in psychological science. *American Psychologist*, *77*(8), 894.

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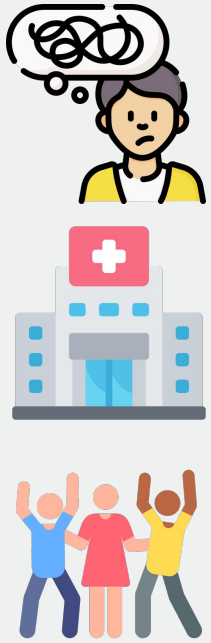
Theory of constructed emotions

"Emotions are not episodes that happen to us, but rather are constructed by the brain in the moment from combinations of basic feelings and past experiences."

Lisa Feldman Barrett (2018/2022)

emphasizes the complexity and variability of emotional experience, and the multiple factors that contribute to the construction of emotions

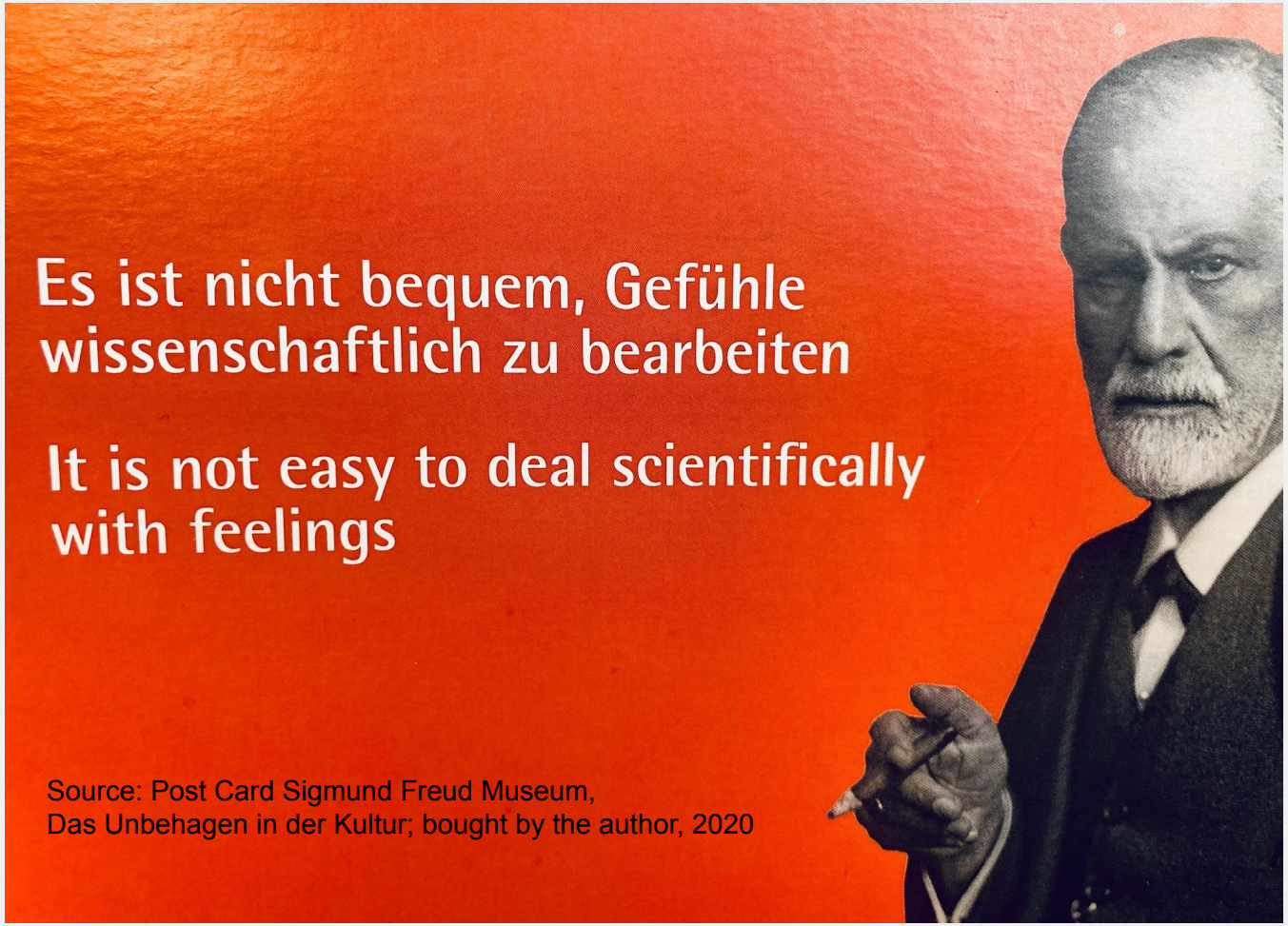
Sidestep: the history and motives to study emotions in psychology



Challenges of dealing with feeling

“One can attempt to describe their physiological signs. Where this is not possible(...) nothing remains but to fall back on the ideational content which is most readily associated with the feeling.”

Source: Sigmund Freud, 1930 retrieved from https://www.stephenhicks.org/wp-content/uploads/2015/10/FreudS-CIVILIZATION-AND-ITS-DISCONTENTS-text-final.pdf 01/23



Source: Post Card Sigmund Freud Museum,
Das Unbehagen in der Kultur; bought by the author, 2020

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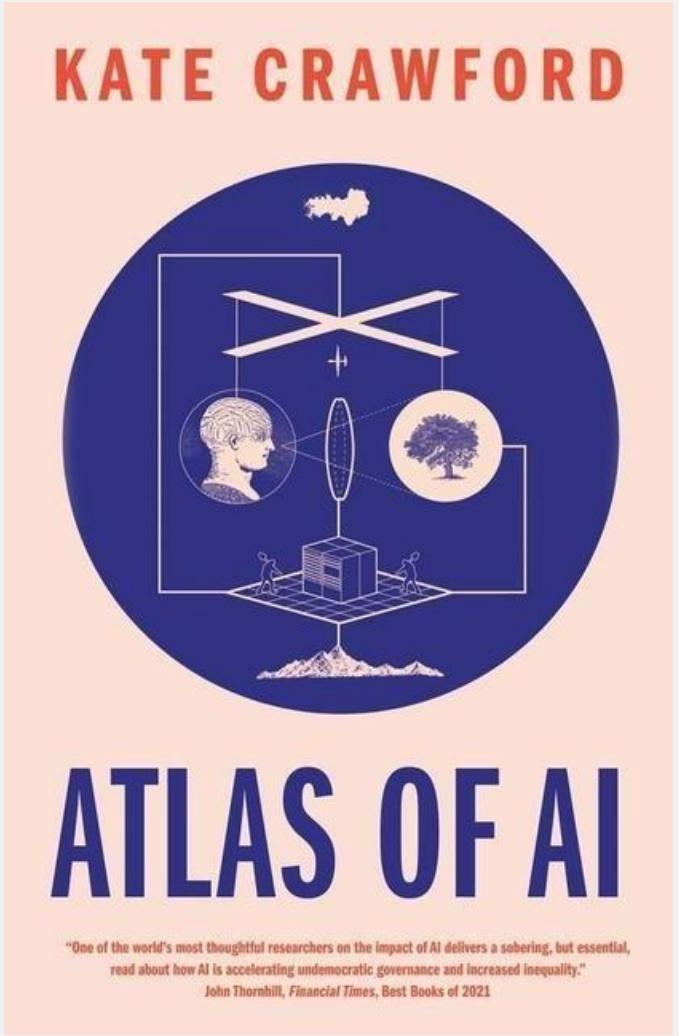
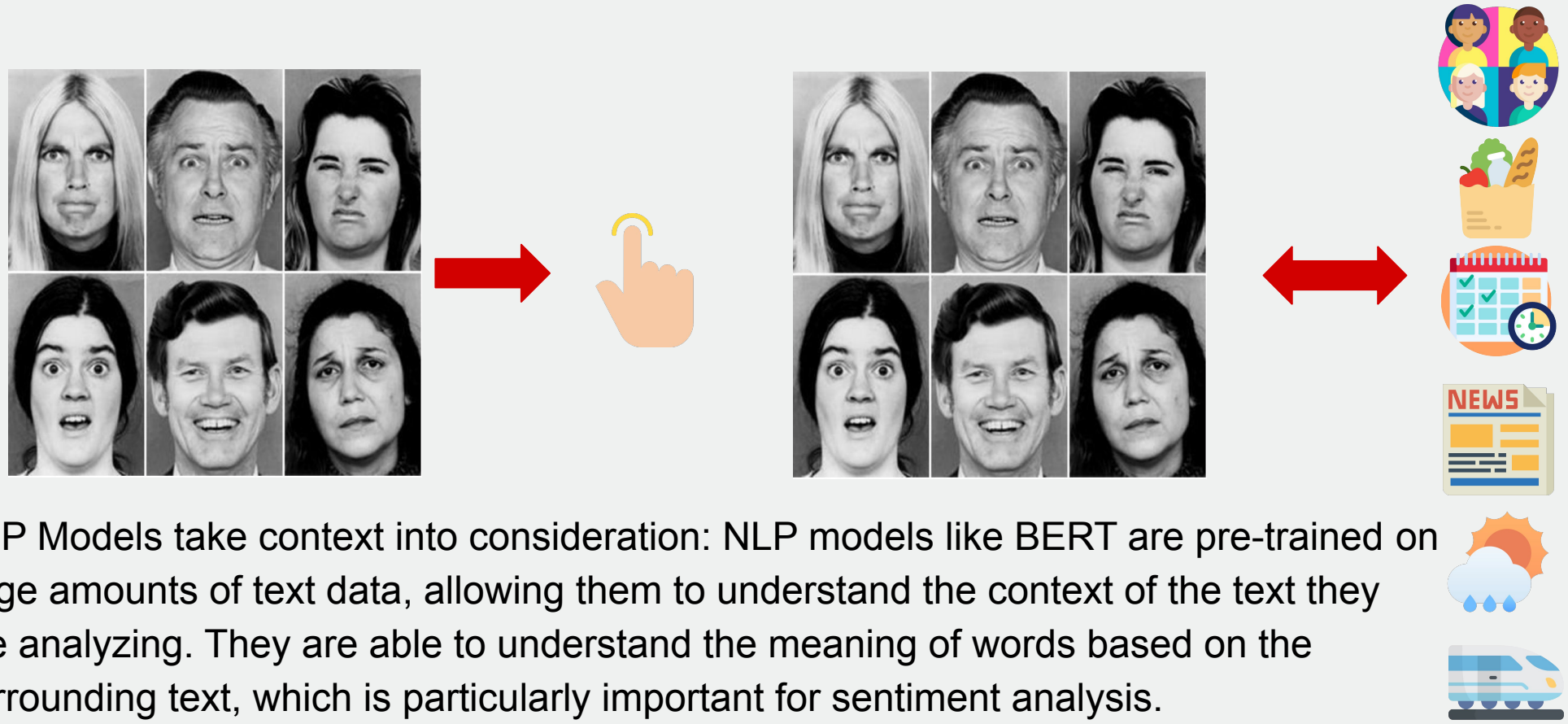
Today: Convenience > Complexity

- potentially problematic use of Ekman's model in the development and use of AI systems, particularly in contexts where the **accuracy and reliability of these systems can have significant consequences, such as in military or law enforcement settings.**
- Crawford has argued that this model, which has been widely applied in fields such as **military and marketing**, **lacks empirical grounding and has been criticized by other researchers, including Lisa Feldman Barrett, for oversimplifying the complexity of emotional experience.**
- risk are to perpetuate biases and stereotypes which can impact daily lives from human resources practices to police enforcement
- **the social and ethical implications of artificial intelligence require to acknowledge complexity**



Crawford, K. (2021). *The atlas of AI: Power, politics, and the planetary costs of artificial intelligence*. Yale University Press.

NLP offers methods to capture the complex and **context-dependent** nature of emotion expression



NLP Models take context into consideration: NLP models like BERT are pre-trained on large amounts of text data, allowing them to understand the context of the text they are analyzing. They are able to understand the meaning of words based on the surrounding text, which is particularly important for sentiment analysis.

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Introducing theory of constructed emotion to sentiment analysis

State of the art cognitive science by Feldman Barrett (2017/2022) show:

- **facial expressions are not reliable indicators of specific emotions, as emotions are constructed in the moment and can vary from person to person.**

- **Emotions are not fixed or innate**, but rather are **constructed by the brain** based on a **combination of past experiences, cultural norms, and the individual's current context.**

Incorporating Barrett's Theory of Constructed Emotion in Sentiment Analysis and Emotion Detection

Current methods of sentiment analysis and emotion detection rely on **pre-defined sets of basic emotions or sentiment labels which may not capture the complexity and variability of emotional experience**

To improve performance, it is important to take into account **context, tone of language, and allow for a wide range of labels and descriptors**

- develop more nuanced and flexible systems for **labeling** emotions, e.g. allowing individuals to use their own words to describe emotional experiences
- use **machine learning algorithm**s that can learn from diverse data, such as text, images, and audio, from multiple languages and cultures

It can be assumed that incorporating the theory of constructed emotion and other state of the art evidence on human behavior can lead to more effective sentiment analysis and emotion detection.

Potential

to go beyond accuracy

CONTEXT & Variability

- acknowledge variation is the norm
- context in which the text is written and the tone of the language used
- wide range of labels and descriptors

capture variation and change over time

Rethinking Psychological Science: The Importance of Context in Emotion Recognition (Feldman Barrett, 2022)

- **Psychological events emerge in ecosystems of signal ensembles**, and the psychological meaning of any individual signal is determined by the other signals in the ensemble.
- The **power of context** to shape one person's experience of another person's face has been consistently noted for thousands of years.
- Considerable scientific opportunities still await for improving the **validity and trustworthiness of psychological science** if we take more seriously the idea of a fully relational science of psychology and reconsider our shared empirical practices accordingly

Source: Barrett, L. F. (2022). Context reconsidered: Complex signal ensembles, relational meaning, and population thinking in psychological science. *American Psychologist*, *77*(8), 894.

Benefits for individuals and societies at large.

Wellbeing
Autonomy

psychological benefits of higher abilities to detect emotions – for machines and humans help in overcoming mechanist views on human experience

Ethical Issues of Digital Wellbeing and applications in recommender systems

- **“Technology is seductive when what it offers meets our human vulnerabilities**.” Sherry Turkle, 2011
- exploration of the impact of digital technologies on what it means **to live a good life as a human being**
- several key social domains: healthcare, education, governance and social development, and media and entertainment need to be addressed

  Source: Burr, C., Taddeo, M., & Floridi, L. (2020). The ethics of digital well-being: A thematic review. *Science and engineering ethics*, *26*(4), 2313-2343.
- In the field of **recommender systems**, researchers have been working to develop more ethical and human-centered systems that align **with human values and promote human well-being**, see e.g., Stray et al., 2022

  Source: Stray, J., Halevy, A., Assar, P., Hadfield-Menell, D., Boutilier, C., Ashar, A., ... & Vasan, N. (2022). Building Human Values into Recommender Systems: An Interdisciplinary Synthesis. arXiv preprint arXiv:2207.10192.

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Understanding Human Autonomy in AI Systems: Implications for Sentiment Analysis

- **Digital technologies are mediating most human experiences**, from health and education to personal relations and politics.
- **Autonomy** has been long established as a critical aspect of research on human motivation, self-determination and philosophy and has been empirically supported as key to motivation, personal growth and psychological flourishing.
- **Responsible AI requires an understanding and ability to effectively design for human autonomy if it is to genuinely benefit humanity.**

Source: Calvo, R. A., Peters, D., Vold, K., & Ryan, R. M. (2020). Supporting human autonomy in AI systems: A framework for ethical enquiry. In *Ethics of Digital Well-Being* (pp. 31-54). Springer, Cham.

Benefits for individuals and insights for society

- identifying the multiple components of emotions.

1. Paying attention to **bodily sensations:** Barrett suggests that emotions are accompanied by specific patterns of physiological changes, such as changes in heart rate, breathing, and muscle tension.
2. Identifying and labeling emotions **using specific words**
3. Reflecting on the **context** in which emotions are experienced: Emotions can be influenced by the environment, culture, and personal history.
4. Understanding that **emotions change ove**r time, e.g., individuals can learn to be more adaptable **and flexible in their emotional responses.**
5. **Cultivating mindfulness:** Barrett suggests that mindfulness practices can help individuals become more aware of their emotional experiences and learn to respond to them in a more constructive way.

Source: Barrett, L. F. (2017). *How emotions are made: The secret life of the brain*. Pan Macmillan.

IMPROVEMENT and further potential Context Aware NLP

Can black box models help to shine light into dark, messy places?

A strange suggestion but a perspective that tries to integrate human complexity and advancements in technology likewise.

Black box models and their potential to explore human emotions more fully and autonomy supporting

An outlook into the discussion on explainale AI and deep neural networks as provide by Edward A Lee (2022)

- **Bounded rationality** posits that humans make decisions based on algorithmic reasoning using logic to maximize utility, but with limited ability to handle complexity and data.
- **Embodied cognition** suggests that a **cognitive mind is an interactive machine,** and interactive machines can accomplish more than algorithmic computation alone.**Embodied bounded rationality** combines the limited resources of bounded rationality with the interactive capabilities of embodied cognition.
- **Deep neural networks**, a recent breakthrough in AI, are interactive and not fundamentally algorithmic, providing evidence for the principle of embodied bounded rationality.
- These **findings suggest that AI more closely resembles intuitive thinking than rational decision making and the goal of "explainable AI" is unattainable in a useful form.**

Source: Lee, E. A. (2022). What Can Deep Neural Networks Teach Us About Embodied Bounded Rationality. *Frontiers in Psychology*, *13*.

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Overcome the disciplinary disconnect of emotion studies

Reconnect to improve both sides

Next Presentation on Benefits of the reconnection.

Toxicity and Populism

Summary

- Introduction to theory of constructed emotions
- application and challenges in emotion research
- disciplinary disconnect
- potential for improvement of psychological science and sentiment analysis in tandem
- human wellbeing, flourishing and societal progress
- future topics for interdisciplinary research

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Discussion Focus Groups: Mural

1. What are the societal and ethical implications of these findings for the development and application of emotion recognition technologies? How do these findings align with or differ from our understanding of emotions in other fields such as neuroscience, sociology or anthropology..?

2. How can the insights from the science of emotion be used to improve machine learning-based emotion recognition? How do NLP models like BERT compare to traditional methods of sentiment analysis and how can we improve these models to better reflect the variability of human emotions?

3. How can we use NLP and media in a way that enhances emotional expression and connection, while minimizing the negative impacts on human relationships and emotional well-being? How can we ensure digital technologies enhance our well-being and autonomy, rather than compromising them in the information society?

4. Ideas for applications, relevant research, future research avenues, open questions

https://app.mural.co/invitation/mural/zoomester20205424/1674589928907?sender=uba035cd9eee10e44d32a8460&key=70fe0a86-a082-4bf2-aa45-9f6c7df115af

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Back Up

(The role of context in a typological view of Emotion)

- Contextual factors are assumed to independently influence the processes that cause emotions.
- Contextual factors are thought to modify the inherent emotional meanings.
- In a typological view of emotion, each type of emotion is a category of many individual instances, each instance can be described as a collection of features (physical and mental)
- Each type of emotion as a category has a prototype which is an instance with a pattern of features that best describes all the category's instances.

Outlook: potential benefits of interdisciplinary collaboration

1. **Natural language processing:** Collaboration between computer scientists and psychologists could lead to the development of more sophisticated and accurate natural language processing systems that are better able to understand and generate human-like text.
2. **Personalization and recommendation systems:** Interdisciplinary collaboration between computer scientists and psychologists could lead to the development of more effective recommendation systems that are better able to personalize content and tailor recommendations to the individual needs and preferences of users.
3. **Predictive analytics:** Collaboration between computer scientists and social scientists could lead to the development of more accurate and useful predictive analytics systems that are able to take into account the social and cultural factors that can influence outcomes.
4. **Machine learning interpretability:** Interdisciplinary collaboration between computer scientists and psychologists could lead to the development of methods for interpreting and understanding the decisions made by machine learning algorithms in a way that is meaningful to social scientists and psychologists.

, studies on emotion should be conducted in a way that allows for nuance of individual variation and respects individuals' autonomy. This could involve using more ecologically valid methods, such as studying emotions in real-world contexts rather than in the lab, and allowing for a diversity of participants with different cultural backgrounds and experiences. Additionally, studies should be designed in a way that respects individuals' autonomy, such as by obtaining informed consent and allowing participants to opt-out of certain procedures or aspects of the study.

supporting human autonomy in AI systems, which states that AI systems should be designed in a way that respects and supports individuals' autonomy, rather than controlling or manipulating them. This would include giving individuals control over their data, allowing them to understand and influence how the AI system makes decisions, and ensuring that the system does not perpetuate bias or discrimination.

One key aspect of this perspective is to recognize that emotions are not fixed or innate, but rather are constructed by the brain based on a combination of past experiences, cultural norms, and the individual's current context. This means that emotions can be influenced by many different factors, such as an individual's personality, social relationships, and physical and mental health.

Another important aspect of this perspective is to recognize that emotions are not limited to a fixed set of basic emotions, but rather exist on a continuum and can be described by a wide range of labels and descriptors. This means that the labeling of emotions should be flexible and open-ended, rather than being constrained by a fixed set of basic emotions