Social Equality: Cognitive Modeling Based on Emotional Coherence Explains Attitude Change

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Abstract

Why do people have conflicting views of equality concerning the distribution of income, wealth, and satisfaction of vital needs? How do people form and sometimes change their views of equality and related issues, such as gender identity? Answers to such questions can benefit from cognitive science—the interdisciplinary field that includes neuroscience and computer modeling as well as psychology. According to principles of emotional coherence, attitudes develop and change because of connections among the values attached to systems of concepts, beliefs, and goals. People attach a positive value to concepts such as equality, if the concept fits with other positive concepts such as human needs, and opposes negative concepts such as poverty. Emotional coherence balances positive and negative values to yield an overall conclusion. Computer models based on emotional coherence explain people's differing attitudes about equality and issues such as transgender rights. They also model how people sometimes change their minds.

Tweet

Different attitudes on equality issues such as transgender rights are explained by coherence with different systems of emotional values.

Key Points

- Policies about social equality can benefit from investigations in cognitive science.
- Differences in attitudes about equality are explained by differences in people's cognitive networks of concepts and beliefs.
- People acquire and change their attitudes about equality because of mental mechanisms of emotional coherence, which balance positive and negative values.
- As an example, attitudes toward transgender rights are explained by their coherence with left-wing ideologies, and their incoherence with right-wing ideologies.
- Theories are relevant to policy when they describe causal mechanisms that can guide interventions.

Introduction

In 2017, the Canadian Parliament overwhelmingly passed a bill extending human rights protections against discrimination to cover "gender identity and expression." That same year, President Donald Trump ordered that transgender people be banned from the U.S. military. What is the psychological basis of such different attitudes toward treatment of people whose sense of personal identity does not correspond to their birth sex?

Controversies about the rights of transgender people reflect differences concerning the nature and importance of human equality. Left-wing ideologies tend to place equality as a central concept along with robust human rights, justifying strong state action to protect people at risk of discrimination and suffering. In contrast, right-wing ideologies often emphasize the right to personal freedom, and limit equality to much narrower concerns with free speech, equal opportunity, and equal legal treatment. Cognitive science can help bridge this divide by identifying key differences and potential areas of common ground.

The social and political importance of equality and inequality makes these concepts ripe for psychological investigations, and various psychologists have conducted studies relevant to understanding its contribution to human

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thinking (e.g., Durante et al., 2017; Starmans, Sheskin, & Bloom, 2017). But theorizing about how mental mechanisms produce thinking about equality has been limited.

Cognitive science uses mathematical analysis and programmed simulations to develop computational models of the mental mechanisms that produce different kinds of thinking. Cognitive models of emotional inference and change can help to fill the gap in theorizing about equality. These models help to answer questions, such as,

1. Why do people have conflicting political views of equality?
2. How do these views generate different inferences about controversial issues such as gender identity?
3. How do people change their views of equality and related issues?

Answers to these questions come from mental mechanisms concerning how emotional values attached to concepts, beliefs, and goals fit into coherent systems. Emotional coherence is modeled by neural networks that show how conflicting values can be balanced against each other.

Equality and Inequality

The concept of equality has been central to political discussions since the eighteenth-century revolutions in America and France, although concerns about equality go back to the Old Testament (Abernethy, 1959).

But what is equality? Dictionary definitions such as "the state of being equal, especially in status, rights, and opportunities" are not informative or useful, even with consultation of the definition of "equal" as "being the same in quantity, size, degree, or value." Moreover, experimental research on the psychology of concepts downplays the importance of definitions. Instead, concepts are marked by three aspects—standard examples, typical features, and explanations that the concepts can be used to provide (Murphy, 2002). For example, the concept of movie star includes the *examples* of Emma Stone and Ryan Gosling, who possess *features* such as being good actors and being physically attractive, which help to *explain* why their films are successful. A new neurocomputational theory of concepts shows how to combine examples, features, and explanations in a unified model of concepts (Blouw, Solodkin, Thagard, & Eliasmith, 2016). This model has practical implications for understanding how people conceptualize politics and social conflicts.

The model suggests how to characterize concepts by identifying their three aspects using a method of conceptual analysis that Thagard (2018a) calls "3-analysis." Table 1 provides a 3-analysis of the concept *equality*. First, the standard examples (exemplars) of equality include historical cases where people have been treated the same irrespective of sex, color, religion, sexual orientation, and so on. Another class of standard examples of equality includes particular kinds of equality such as

Table I. 3-Analysis of *Equality*.

Exemplars	Same treatment of men, women, people of color, gays, and so forth Equality of human rights, opportunity, income, wealth, and so forth
Typical features	Same treatment, same resources, fairness, recognition, vital needs satisfaction
Explanations	Explains why people view some organizations such as countries as fair and just; why there is little agitation for social change

equal rights to free speech, equality of opportunity, and equality of legal treatment.

Second, the typical features of equality include people getting the same treatment, fairness, and recognition that their humanity is not diminished by characteristics such as being of a particular sex, race, religion, sexual orientation, and status in general. Social equality does not require that people be identical with respect to physical features and talents, only that they are equal in opportunities to satisfy the needs required to flourish as human beings (Walzer, 1983). Such requirements cover both biological needs (food, water, air, shelter, healthcare) and psychological needs of autonomy, relatedness, and competence (Ryan & Deci, 2017; Thagard, 2018b).

Finally, the concept of equality has an important explanatory role, helping to answer questions such as why people in some organizations are satisfied or not. The concept of equality also has a strong moral dimension, explaining why selective oppression and discrimination are often viewed as wrong.

Inequality is not just the absence of equality. Table 2 gives a 3-analysis of the concept of inequality that presents its standard examples, typical features, and explanatory role. First, the exemplars of inequality include enslavement of people based on their race, discrimination against women with respect to voting and jobs, oppression of minority religious groups, and mistreatment of gay and lesbian people. Economic inequality is also prominent, both in absolute terms (hundreds of millions of people in the world with almost no income) and relative terms (the disproportionate share of wealth of the top 1%). Second, inequality's features are marked by violations of human rights, unfairness, and lack of recognition. Third, the concept helps to explain why American and French revolutionaries were so resentful of tyranny, and why subordinated people and their allies today become activists in trying to overcome social oppression of particular groups.

How Cognitive Models Are Relevant to Equality

Theories are relevant to policy when they describe causal mechanisms, that is, combinations of connected parts whose

Table 2. 3-Analysis of *Inequality*.

Exemplars	Slavery, discrimination against women, religious oppression, gay people arrests, poverty, maldistribution of wealth
Typical features	Human rights violations, unfairness, and lack of recognition
Explanations	Explains why people resent bigots and tyrants; why the oppressed and their allies agitate for social change

interactions produce regular changes (Thagard, 2012a). When causal connections are identified, interventions can modify them to improve lives. For example, if contaminated water causes diseases such as cholera and typhoid, then public health agencies can intervene to remove contamination and stop disease.

In contemporary cognitive science, there are two kinds of mechanistic explanations. In the form most common since the 1950s, the parts are mental representations such as concepts and rules, and the interactions are computational processes such as spreading activation and inference. Since the advent of cognitive neuroscience in the 1970s, another style of mechanistic explanation has developed, where the parts are neurons, the connections are synapses, and the interactions are neural excitation and inhibition. These two kinds of mechanisms coalesce when the operations of neural networks are used to explain how mental representations and processes work (e.g., Rumelhart & McClelland, 1986; Thagard, 2018a).

Mental mechanisms are relevant to policy issues that require people to change their minds about what to believe and what to do. For example, reducing pollution requires educating people to change their attitudes and legislating people to change their behaviors. Cognitive models are relevant to equality when they provide descriptions of representations and processes that provide mechanistic explanations. The phenomena to be modeled include the divergent understandings of equality (Left vs. Right), the different conclusions about controversial issues such as transgender rights, and the changes that occasionally take place in people's minds about equality and its applications.

To explain these phenomena, I will use a theory and model of emotional coherence that has been applied to many phenomena such as motivated inference, biased legal reasoning, and religious belief (Thagard, 2006, 2018c). The relevance of emotions to issues about equality is obvious. When people think and argue about equality, they are not merely engaging in cold, cognitive reasoning processes. Opposition to inequalities is always passionate, and defense of the status quo against equality-based challenges is also emotionally motivated. Traditionally, the fields that have informed policymaking—such as rational choice theories and judgment and decision-making—have tended to ignore emotion, mood, and motivation. But recent models show

how emotion can enter into mental mechanisms of policy-relevant concepts.

Emotional Coherence

The theory of emotional coherence is summarized in these principles:

1. Mental representations such as concepts and beliefs have evaluations attached: positive or negative emotional valences.
2. These representations can have positive or negative emotional connections to other elements.
3. The valence of an element is determined by the valences and acceptability of all the elements to which it is connected.

For example, proponents of equality attach positive emotional valence to the concept *equality*, and negative valence to contrary concepts such as *discrimination*. The computed valence for introduced concepts such as *transgender rights* depends on the emotional connections to other representations.

Emotional coherence can be efficiently computed by neural networks (Thagard, 2006). Simon, Stenstrom, and Read (2015) present studies that support the psychological plausibility of emotional coherence. Emotional coherence is similar to ideas familiar to psychologists such as balance, dissonance, and attitude adjustment (Fiske, 2014; Heider, 1958; Olson & Fazio, 2008). But it deepens these ideas by providing a neurocomputational mechanism that explains many psychological phenomena.

A convenient way to display the emotional coherence of a group of values is the method of cognitive-affective mapping (Homer-Dixon, Milkoreit, Mock, Schröder, & Thagard, 2014; Thagard, 2012b, 2018a). These maps provide a convenient way to highlight differences in conflicting views of equality. Figure 1 uses ovals to represent emotionally positive concepts such as food, and emotionally negative concepts such as hunger, along with their relations of support and incompatibility. I now apply these maps and the emotional coherence theory to three policy-relevant questions about equality.

Modeling Different Views of Equality

The article so far has placed equality as a positive value at the center of political discourse, but some ideologies disagree. Libertarians maintain that equality is subordinate to the much more fundamental value of freedom. Farther right, fascists reject doctrines of universal equality altogether, maintaining that some categories of people (e.g., Whites) are inherently superior. At the Far Left, Marxists are also dubious about equality because of their focus on class struggle between the proletariat (working class) and the bourgeoisie
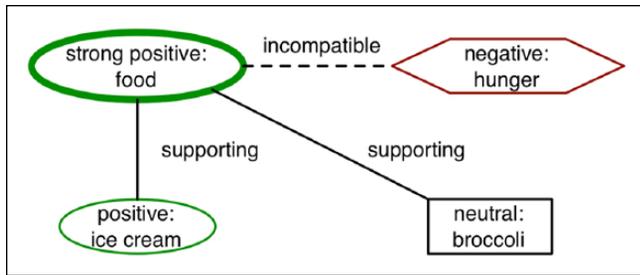
Figure 1. Cognitive-affective map of positive, negative, and neutral valences, with connections.
Note. Ovals represent emotionally positive values, hexagons represent negative values, and rectangles represent neutral ones. Thicker lines indicate stronger values. Where color is available, ovals are green, hexagons are red, and rectangles are black or yellow. Solid lines indicate supporting connections (excitatory links), whereas dotted lines indicate emotional incompatibility (inhibitory links).

(owners of the means of production). The appeal of ideologies to their supporters can be modeled by emotional coherence as displayed in cognitive-affective maps.

Social Democracy (U.S. Liberals)

Social democracy is an ideology that supports government interventions to promote justice understood as providing a high degree of social and economic equality (Giddens, 1999). Social democracy differs from socialism in recognizing the contributions of capitalism to freedom and economic growth, but pursues government actions to alleviate the inequalities that capitalism produces. In the United States, social democracy is represented by the liberal left wing of the Democratic Party, for example, Bernie Sanders. Social democracy is much more prominent in other countries such as the United Kingdom (Labour Party), Canada (New Democratic Party), Germany, and the Scandinavian countries. Accordingly, these countries have more egalitarian social policies than the United States, for example, universal healthcare. A good expression of the social democratic view of equality is the United Nations Universal Declaration of Human Rights. In the United States, social democratic views are sometimes called "liberal," not to be confused with the more conservative ideology of libertarianism.

What mental mechanisms make this ideology appealing to its advocates? Social democracy (American liberalism) has a coherent set of values with equality at its core, as shown in Figure 2. Equality has supporting connections with human rights and needs, along with specific policies such as healthcare and social welfare. Government is a positive value because of its contributions to social welfare, but capitalism is neutral because its contributions to economic development are counterbalanced by risks of exploitation and poverty.

Not shown in Figure 2 is the strong connection between rights and human needs. According to many contemporary theorists, the secular basis of rights and equality is the universality of vital human needs such as food, water, shelter,

and interpersonal relationships (Orend, 2002; Sterba in Narveson & Sterba, 2010; Thagard, 2018d; Walzer, 1983). People cannot be equal in all respects, but society can strive to ensure equality with respect to satisfaction of vital needs (Thagard, 2018b).

Figure 2 is not just a static map, but also points to a dynamic cognitive model in which the valence of an element is influenced by the valences of all the representations to which it is connected, ensuring overall evaluative consistency. For example, the positive valence and acceptability of equality as a core value derives from its interactions with other values, including mutual support with the concepts of human needs and rights, and its opposition to negative values such as poverty and exploitation. The model can explain why social democrats tend to accept rights to gender identity and expression because of their emotional coherence with the values in Figure 2.

### Libertarianism (U.S. Conservative)

Many people reject the package of values shown in Figure 2, preferring a larger emphasis on personal freedom and capitalism, with a much more limited role for government, equality, and rights. People who espouse this opposing view go by various labels, including "conservative," "classical liberal," "neoliberal," and "libertarian." Classical liberalism is associated with historical figures such as John Locke, and with more recent thinkers such as Friedrich Hayek (Butler, 2015). In the United States, libertarians are common in the Republican Party, emphasizing individual liberty and a limited role for government over concerns about social equality. Conservative parties espouse similar values in countries such as the United Kingdom and Canada.

The emotional coherence of the libertarian ideology is shown in Figure 3. In contrast to the centrality of equality in the social democratic map in Figure 2, the most important value in this map is freedom. This value is opposed to taxation and regulation, although government can be viewed as neutral because it sometimes supports private property and equality before the law. Equality is fine as long as it is restricted to equality of opportunity, but income equality is antagonistic to the positive values of capitalism, economic development, and individual freedom from taxation and regulation. The concept of human rights is much narrower than the social democratic view, supporting private property and individual freedom from coercion, but not social policies to overcome inequalities in income and satisfaction of vital needs.

Figure 3 also depicts a dynamic cognitive model and not just a static structure. The concept of freedom gets its strong positive valence from its positive associations with private property, capitalism, and economic development, and also from its incompatibility with taxation and regulation. This configuration of values can lead to skepticism about extension of human rights to include gender expression and identity.
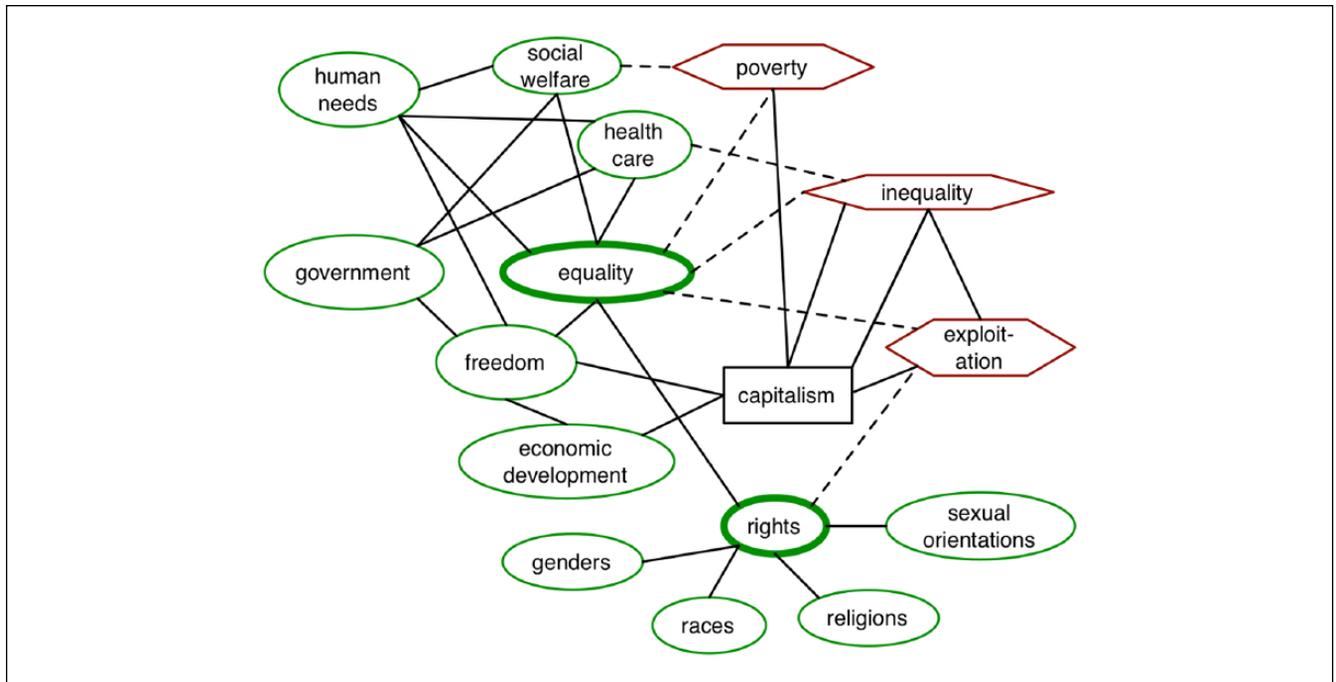
Figure 2. Cognitive-affective map of social democratic (liberal) values.
Note. Ovals are emotional positive, hexagons are negative, and the rectangle is neutral. Solid lines indicate mutual support, and dotted lines indicate incompatibility.
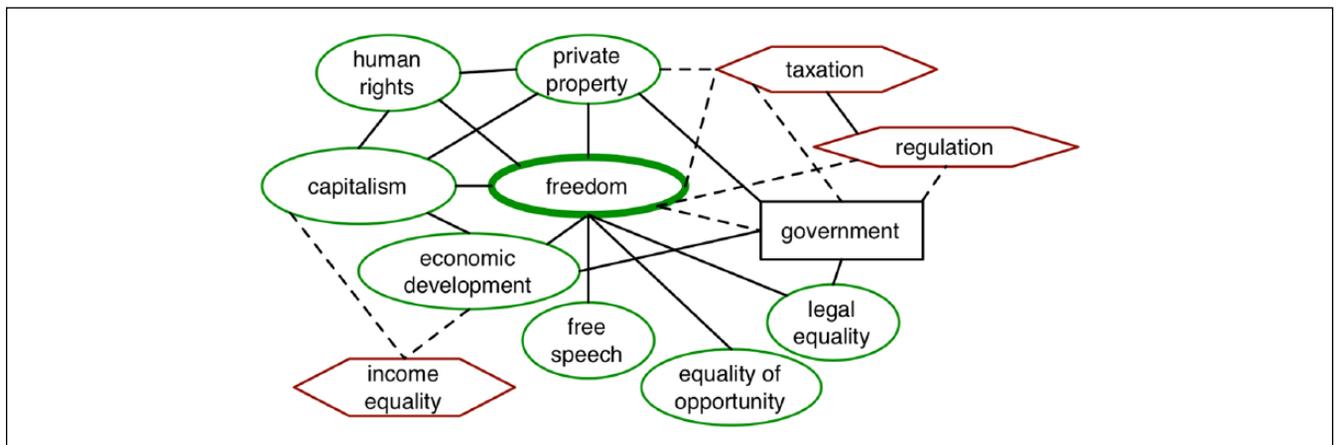

Figure 3. Cognitive-affective map of libertarianism.
Note. Mapping conventions are the same as for Figure 2.

How Do Different Views of Equality Predict Attitudes?

Possession of a left or right ideology largely explains attitudes toward particular issues such as universal healthcare, gun control, and transgender rights. This section uses cognitive-affective maps and simulations to explain why social democrats (liberals) tend to favor transgender rights, whereas libertarians (conservatives) reject them.
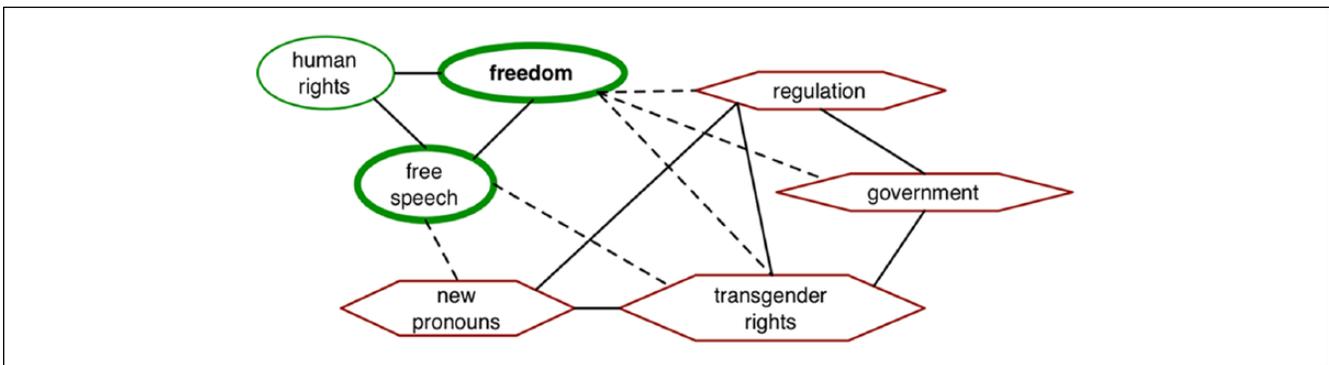
For Transgender Rights

Figure 4 shows a configuration of values that can lead social democrats to support transgender rights. Strong values of equality and rights, based on human needs, support more particular rights for men, women, people of different races and religions, and gays and lesbians. Analogously, people with nonbinary gender identities are at risk of unequal treatment, discrimination, and even violence. Hence, rights for people
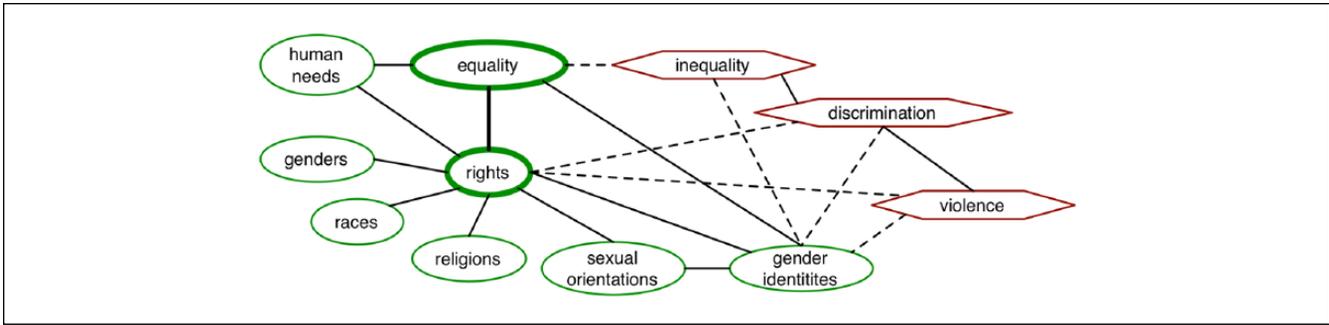
Figure 4. Components of social democratic values (from Figure 2) that support extension of human rights to cover gender identity and expression.
Note. Mapping conventions are the same as in Figure 2.

Figure 5. Components of libertarian values (from Figure 3) that resist extension of human rights to cover gender identity and expression.
Note. Mapping conventions are the same as in Figure 2.

who are transgender or otherwise unorthodox in gender identity and expression should be added to the list of prohibited grounds of discrimination.

In the cognitive-affective map in Figure 4, transgender rights get support both from concepts of equality and rights, and from incompatibility with negatively valenced concepts of inequality, discrimination, and violence. The link between gay rights and transgender rights reflects that these are viewed as analogous. Figure 4 shows the result of balancing of valences, with the positive valence for gender identities deriving from support from positive values such as rights, and incompatibility with negative values such as violence. Therefore, emotional coherence (as implemented in a valence-spreading neural network) is a plausible mechanism for explaining why social democratic values lead to positive attitudes toward transgender rights.

Against Transgender Rights

In Canada, opposition to the bill that outlawed discrimination based on gender identity came from some conservatives. They argued that it would lead to enforced use of gender-neutral pronouns such as "they" and concocted ones such as

"ze" (Pardy, 2017; Peterson, 2016). This result was viewed as a violation of free speech, extreme not only in prohibiting kinds of speech such as calling a transgender woman "he," but also requiring people to speak using only whatever pronouns people prefer.

Figure 5 extracts from Figure 3 the values most relevant to reaching the conclusion that there should be no government protection based on gender identity and expression. The values of freedom and free speech lead to negative valences for the configuration of government regulation of transgender rights that might require people to use new pronouns. Legal experts such as the Canadian Bar Association insisted that the bill only outlawed hate propaganda without mandating pronoun use. But critics pointed out that the Ontario Human Rights Commission (2018) specifies that a person's chosen name and pronouns are a common way of expressing gender.

The emotional coherence computation that corresponds to Figure 5 provides initial positive valence to the concepts of freedom and free speech, whose inhibitory connections with the concepts of regulation, government, new pronouns, and transgender rights leads to their having negative emotional values as an undesirable package. Transgender rights are

rejected as being incompatible with core values of freedom and free speech.

There are other ideological configurations that can lead to the rejection of rights based on gender identity and expression. Fascists might reject transgender people for the same reason the Nazis persecuted gays, whom they regarded as threats to Aryan cultural purity. Religious conservatives might discriminate against nonstandard religious identities because they think that religious texts (e.g., the Bible and Quran) establish just two sexes, male and female.

But the libertarian rejection of transgender rights can be based solely on considerations of freedom and the right to free speech. The theory of emotional coherence explains how conservative values can lead to rejection of transgender rights.

How Can Views of Equality Change?

Political views are often highly polarized and intransigent to change, but transitions do sometimes occur. For example, gay sex was illegal in Canada until 1969, but same-sex marriage has been legal since 2005; more than 20 other countries including the United States have changed similarly. Historically, equality and human rights were initially assigned to White men in eighteenth-century United States and France, but extensions to cover people of different races, sexes, and sexual orientation have occurred over the centuries.

What are the mental mechanisms responsible for changes in general attitudes toward equality and changes in specific attitudes concerning issues such as gender identity? The theory of emotional coherence provides explanations that fit the following pattern:

1. Attitudes and actions result from configurations of emotionally coherent values.
2. Information and persuasion can lead to different configurations.
3. When a new configuration has more emotional coherence, it supplants the old one.
4. Hence, attitudes change as the result of a holistic process of adjustments of multiple values.

This pattern is rather vague, but the neural network model provides a more specific description, in line with the cognitive-affective map depiction of value systems. This account is consistent with decades of psychological research on attitudes and persuasion (Petty & Cacioppo, 2018), but goes beyond it by providing a neurocomputational causal mechanism that can guide policy-motivated interventions.

So, from the perspective of emotional coherence, attitude change requires introducing new concepts and connections between them that lead to lasting emotional switches in the configuration. Then, the question of changes in attitudes about equality becomes, "How can values and connections among them be altered to produce different evaluative judgments?"

Because I hold a social democratic view of equality and transgender rights, and because libertarian conservatives are the main opposition, I will describe change as the attempt to convince libertarians to modify their views of equality and transgender rights. But the mechanisms I describe are general, applying to changes in many directions, even to extreme ideological changes such as an anarchist becoming a fascist or vice versa. Changes in values and connections should suffice to explain all changes in attitudes about equality, Right to Left or vice versa, not just the ones I endorse.

Arguments and Belief Change

Philosophers often assume that people change their minds because they are convinced by arguments to alter their beliefs, but psychologists view influence as resulting from many other kinds of interactions (Cialdini, 1984). Sterba tried to convince Narveson that libertarians should agree on their own principles that poor people have a right to expect more equal distribution of resources from rich people (Narveson & Sterba, 2010). Unsurprisingly, Narveson rejected the argument, sticking to a narrow understanding of rights that rejects redistribution of income. Arguments rarely change people's minds.

Nevertheless, belief revision can sometimes contribute to value change because emotions are neural combinations of physiological perceptions (e.g., changes in heart rate and stress levels) and cognitive appraisals (judgments about how situations fit with goals; Thagard, 2018a). The physiological dimension of emotion is impervious to argument, but some appraisals depend on beliefs that can be challenged by evidence. For example, a libertarian might claim that equality is not a good social goal because it leads to socialism, which leads to totalitarianism. In response, a social democrat could point to many cases where concerns with equality have led to beneficial social programs such as universal healthcare without the drastic elimination of private companies that socialism requires.

A proponent of transgender rights can respond to conservative arguments that changes in pronoun practices are a threat to free speech. No one is compelled to use special pronouns such as "ze" preferred by some transgender people, because no one is compelled to use pronouns. Alternatives include using proper names, descriptions, and simply pointing to people. Libertarians presumably recognize that some forms of speech are harmful, such as derogatory racial terms, and should analogously be able to recognize that misuse of pronouns can be harmful.

Other beliefs about equality that can have an impact on emotional attitudes include strong assumptions about a genetic basis for determinants of inequality such as intelligence. Some people argue that equality is a hopeless ideal because people

largely inherit their intelligence, which is a major determinant of economic success. Providing evidence against such beliefs might help to undermine negative attitudes toward inequality based on race, sex, and gender identity.

Empathy and Sympathy

Another way of changing minds about the plights of people who have suffered from inequality is by empathy and sympathy. Empathy is approximately feeling what other people experience by imagining what it is like to be in their situation (Decety, 2014). Empathy can sometimes lead to sympathy, which is feeling sorry for someone's misfortune. Empathy and sympathy sometimes function to change attitudes toward downtrodden people. For example, a person with a disdainful attitude toward homeless people might be encouraged to imagine what it is like to be sleeping in the streets, cold and hungry, with a long history of mental and social problems. Empathic identification, then, can lead to feeling sorry for homeless people and a desire to alleviate their suffering.

How does empathy work as a psychological process? Thagard (2018a, 2018c) distinguishes three modes of empathy that employ different mental mechanisms. The most verbal is analogical mapping, where you consciously describe a person's situation, map it onto some previous experience of your own, and then transfer your recollected emotional state to the other person. For example, if you have suffered some kind of discrimination, you can see the situation of a transgender person as analogous to your own history, remember how you felt, and project this on to the other.

A much more visceral and nonverbal kind of empathy is produced by mirror neurons that fire in your brain when you perceive physical actions involving another person. If you see someone punched in the stomach, then you may flinch or grunt as if you yourself had been punched in the stomach, because the same neurons are firing in your brain as would fire if you actually had been punched. Then, without the complexity of analogical mapping or verbal representation, you can have an empathic reaction to what happens physically to another person, for example, to transgender people subject to violent acts.

The third mode of empathy is nonverbal, as with neural mirroring, but has more extended structure, as with analogical mapping. If you witness someone's ongoing actions, you can approximately simulate their behaviors by a series of your own actions and attendant experiences. For example, if someone is insulted, pushed down, and struggles to get up, you can duplicate the series of actions in your visual and kinesthetic imagination, leading to a series of emotional experiences. This mode of empathy is more complex than using mirror neurons, because it requires more than a simple reaction. Instead, a simulation with a series of actions produces an empathic reaction that involves a series of emotions. The result can be a rich empathic experience that inclines you toward sympathy about the unequal situation of someone undergoing prolonged suffering.

Conceptual Change

Changing attitudes may require substantial changes in concepts (Vosniadou, 2013). The most striking kind of conceptual change is the introduction of new concepts that people can apply to themselves and others in ways that alter behavior. Introducing new concepts such as "transgender" and "homeless" can give people different ways of thinking about complex situations, and open up the possibility of changing attitudes. For example, in North America, replacing the historically erroneous term "Indian" by "indigenous" can help in changing the emotional evaluation of a group of people.

In some cases, new concepts need to be introduced into the culture and the individual. For example, the concept *transgender* only appeared in books in the 1990s, according to Google Ngram. But a concept needs to be more than generally available: To have an impact on people's thinking, it needs to be introduced into the conceptual system of each individual. Skeptics may simply refuse to recognize that a concept has any useful reference, for example, by claiming that there are no genuine exceptions to the traditional genders of male and female. Equally challenging is revising the connections between the concepts in emotional networks. These connections are sometimes based on factual claims, for example, that transgendered people are often subjected to violence.

Other kinds of conceptual change are marked by changes in the 3-analysis of a concept. Media can bring new standard examples, for example, when television shows in the 1980s began to show sympathetically presented gay characters. More recently, television in the 2010s has depicted likable transgender characters in shows such as *Orange Is the New Black* and *Transparent*. Different exemplars with alternative valences can thereby help to change the emotions associated with concepts.

Similarly, concepts can change by adding, deleting, or replacing typical features. For example, one's concept of a homeless person alters in a major way if one replaces a typical feature of laziness by mentally ill. This kind of conceptual change is a matter of belief revision based on evidence.

Changes in typical features go hand in hand with changes in explanations by the relevant concepts. Concepts provide explanations via their typical features that are associated with behaviors, for example, when you explain people being polite by pointing out that they are Canadian. Similarly, concepts such as *transgender* can have an explanatory role, for example, in explaining why someone is sensitive about pronouns.

A major part of changing conceptual attitudes may be tied to what explanations are given for them. Very different attitudes about poverty go with conflicting explanations for why

some people are poor, such as God's will, stupidity, laziness, bad luck, personal choice, discrimination, and oppression. The explanations for why people fall under a concept are an important part of why they are viewed positively or negatively.

There are still no accepted scientific explanations for sexual orientation and gender identity. Candidates included genetics, epigenetics, early childhood learning, later social learning, and personal choice. Greater tolerance tends to accompany views that emphasize that people are "born this way," presumably as a result of genetic and epigenetic mechanisms.

Conclusion

Space restrictions do not permit discussion of numerous additional issues about the relevance of cognitive science to equality. What are values? Which particular emotions such as pride and shame are associated with equality and inequality? Can thought experiments such as the social contract help to change attitudes about equality and particular issues? How should we understand the needs that underlie plausible assessments of the morality of equality and inequality? Why is polarization more common in discussions of equality than consensus? How can overcoming inequality be philosophically justified with respect to vital human needs (Thagard, 2018b)?

Nevertheless, this article has shown that equality is not just a problem to be investigated by economists and philosophers, but can benefit from empirical and theoretical investigations in cognitive science. I have explored the explanatory uses of cognitive models of attitudes about equality, both general and specific. Models such as emotional coherence can illuminate differences in attitudes about equality and issues such as transgender rights, and explain how people sometimes change their minds.

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