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ARTICLE

The evaluative information ecology: On the frequency and diversity of "good" and "bad"

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ABSTRACT

We propose the Evaluative Information Ecology (EvIE) model as a model of the social environment. It makes two assumptions: Positive "good" information is more frequent compared to negative "bad" information and positive information is more similar and less diverse compared to negative information. We review support for these two properties based on psycho-lexical studies (e.g., negative trait words are used less frequently but they are more diverse), studies on affective reactions (e.g., people experience positive emotions more frequently but negative emotions are more diverse), and studies using direct similarity assessments (i.e., people rate positive information as more similar/less diverse compared to negative information). Next, we suggest explanations for the two properties building on potential adaptive advantages, reinforcement learning, hedonistic sampling processes, similarity from co-occurrence, and similarity from restricted ranges. Finally, we provide examples of how the EvIE model refines well-established effects (e.g., intergroup biases; preferences for groups without motivation or intent) and how it leads to the discovery of novel phenomena (e.g., the common good phenomenon; people share positive traits but negative traits make them distinct). We close by discussing the benefits relative to the drawbacks of ecological approaches in social psychology and how an ecological and cognitive level of analysis may complement each other.

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Introduction

Social psychological research is at heart concerned with the interaction of the individual with the social environment. A single person may stop at a red light, but if three others ignore the red light and cross the street anyhow, the chances substantially increase that the target person also ignores the red light

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(e.g., Cialdini & Goldstein, 2004). This sets social psychology apart from psychological disciplines that locate their phenomena and explanations mainly within the individual itself, such as cognitive or developmental sciences. In contrast, the social environment is a major explanatory construct within social psychology. Some of social psychology's most famous experiments have become famous just because they illustrate the social environment's powerful influence; for example, Asch's (1956) experiments on conformity or Milgram's (1963) studies on obedience. Given this background, it is astonishing that social psychological theorising has largely neglected regularities within the social environment. While social psychology has a wide array of models and theories for the person – their needs, thoughts, and feelings – and the interaction of the person with specific situations, theories and models of the social environment *per se* are scarce. This is the more astonishing given the impact of classic examples that formalised the environment, such as Lewin's field theory (1939), Latané's social impact theory (1981), and more recently, the DIAMONDS taxonomy of social situations by Rauthmann et al. (2014).

Here, we introduce a model of the social environment with regard to the structural properties of evaluative information, that is, positive and negative, or "good" and "bad" information. We refer to this model as the Evaluative Information Ecology (*EvIE*). Concretely, this model assumes that positive information is in general more *frequent* than negative information and positive information is in general less *diverse than*/more *similar to* other information of the same valence, compared to negative information. With regard to frequency, this implies that people typically meet more friendly than unfriendly people every day (i.e., positive social interactions), that they have more enjoyable food than unenjoyable food (i.e., positive sensory experiences), and that they feel more pleasant than unpleasant affect (i.e., positive emotions). With regard to diversity and similarity, this implies that a friendly person should be more similar to other friendly people compared to how similar an unfriendly person is to other unfriendly people; enjoyable meals should be more similar to each other than unenjoyable meals; and positive feelings should be more similar to each other than negative feelings.

In the following, we first describe the EvIE's specific assumptions in more detail. Next, we provide evidence for its assumptions (i.e., differential frequency and diversity/similarity of positive and negative information). The reviewed frequency evidence builds largely on work by other researchers, while the similarity evidence was largely collected by our group. Next, we describe implications of this model for classic effects in social psychology (e.g., halo effects, intergroup biases) and newly discovered phenomena that follow from the model's assumptions (e.g., the common good phenomenon). We close with a comparison of the model with existing ecological models and we discuss the benefits and drawbacks of using the external ecology as an explanatory construct within social psychology.

The evaluative information ecology

The EvIE model makes two assumptions about the properties of evaluative information in people's environment. First, positive information is more frequent compared to negative information. Second, positive information is more similar/less diverse compared to negative information. These two structural differences have been acknowledged by a number of authors to varying degrees (e.g., Boucher & Osgood, 1969; Matlin & Stang, 1978; Peeters & Czapinski, 1990; Rozin & Royzman, 2001). Most trace differences between positive and negative information back to *intra-psychic* explanations, for example, affective or motivational components within the organism (see Fiedler, 2014, for the concept of intra-psychic explanations). For example, Peeters and Czapinski referred to the greater "urgency" of negative events (see also Peeters, 2002). Rozin and Royzman stated that there is a "bias" to assign more weight to negative events. And Baumeister, Bratslavsky, Finkenauer, and Vohs (2001) suggested that "it is evolutionarily adaptive for bad to be stronger than good" (p. 325). Most akin to our present model, Rozin, Berman, and Royzman (2010) stated that: " … most of the events experienced in life have positive implications … negative events come from a more differentiated set of situations … " (p. 536).

In agreement with Rozin et al. (2010), we take an ecological approach to explain differential frequency and diversity of positive and negative information. We propose that people's social environment is truly marked by the higher frequency of positive information relative to negative information, and by the higher similarity/lower diversity of positive information relative to negative information. To be precise, without an organism and its needs and goals that interact with reality, an empirical state is neither good nor bad. Valence or evaluation is a function of the goals and needs within the individual. In other words, there is a *substance* of reality, and an *evaluation* of reality, a distinction which is more elaborated by Leising, Scherbaum, Locke, and Zimmermann (2015). The distinction can also be traced back to Brunswik's (1955) definition of an ecology as the "objective, external potential offered to the organism", which provides input that "exists prior to and regardless of its recognition or consumption by the responder" (p. 198; the input being potential "nourishment" in the statement).

The difference between substance and evaluation is easily illustrated. Salt water is a good environment for a herring, but a bad environment for a trout, and vice versa. Neither salt nor fresh water, the reality's substance, is good or bad *per se*. These environmental features are transformed into good or bad features by an organism's goals and needs. Similarly, for humans, a hot drink might be good stimulus on a cold day, but not on a hot day. However, "salty", "sweet", "hot", and "cold" are attributes that in interaction with the organism's needs and goals lead to evaluations. The EvIE's assumptions are concerned with the properties of reality's evaluation. Thus, we propose the substance of people's reality leads to a higher frequency of evaluatively positive information, and lower similarity/higher diversity of evaluatively negative information.

Table 1 illustrates the difference of substance and evaluation for the assumed frequency and similarity properties and distinguishes between an *intra-psychic* and an *ecological* approach (Fiedler, 2014). Table 1 denotes reality's substance as S and people's evaluation of this substance as E. A plus sign for an S indicates that most people should evaluate this substance instance as positive most of the time. For example, most people will evaluate a hug positively and a slap in the face negatively. Table 1 denotes frequency by the number of instances of S and E, and similarity by the distance of the Ss and Es. The three E+ values compared to one E- value illustrate a higher frequency, and the smaller distance between the E + s compared to the E-s indicates higher similarity.

Table 1's left half illustrates the psychological approach. The underlying substance is typically not considered. If the frequency and similarity assumptions for E hold, the relevant question on the left side would then be *why* people subjectively experience positive information more frequently and why they perceive positive information as more similar compared to negative information. Table 1's right half illustrates the ecological approach. Here, the underlying substance leads to the structural properties on the evaluation level. The outcome of interest is also the higher frequency of positive evaluations and their higher similarity compared to negative evaluations, but the relevant question is *why* the ecology's substance might be shaped in a way that leads to the differential frequency and similarity of positive and negative information.

Table 1. The role of substance and evaluation for psychological and ecological approaches to differential frequency and similarity of positive and negative information.

	Psychological approach			Ecological approach		
			Frequency property			
Substance	–––			S + S + S + S-		
Evaluation	E + E + E+	E-		E + E + E+		E-
			Similarity property			
Substance	–––			S- S + S + S-		
Evaluation	E+E+	E-	E-	E+E+	E-	E-

Note: Substance instances that most people will evaluate as positive or negative are denoted as S+ or S-, respectively. Positive and negative evaluations are denoted as E+ and E-, respectively. The empty cells for Substance on the psychological side indicate that these are typically not considered. The left half of the table assumes that the properties emerge on the side of the organism, while the right half assumes the properties result from the ecology.

As an example, consider the case of personality traits (i.e., evaluation) a person may infer from other people's behaviours (i.e., substance). Our model assumes that the person will factually observe more behaviour that warrants the inference "friendly" and "diligent" (i.e., positive traits), rather than "mean" or "lazy" (i.e., negative traits). In addition, there are fewer unique types of behaviours that lead to inferences of positive traits (i.e., less diversity), and these fewer traits are more similar to one another. The person will observe more diversity and less similarity within behaviours that warrant inferences to negative traits, for example, "selfish", "mean", "lazy", and "distant". Behaviours that warrant inferences to positive traits will be less diverse and more similar to each other, for example, "open" and "friendly". We propose that these properties are not restricted to traits, though, but apply to social situations (e.g., meetings, conversations), activities (e.g., going for a walk, eating), symbolic experiences (e.g., reading, watching TV), and affective states (e.g., emotions, moods). The model makes the strong claim that anything that involves evaluations follows the frequency and similarity/diversity properties.

On a pragmatic level, the ecological and the psychological approaches depicted in Table 1 lead to similar predictions, as the assumed EvIE properties are investigated on the evaluation level; and for most of the implications that follow below, an "intra-psychic" approach and an "ecological" approach lead to similar predictions. On a meta-theoretical level though, Table 1's left side explains intra-psychic phenomena (e.g., greater differentiation of negative information) with other intra-psychic phenomena (e.g., more attention to negative information). The ecological explanation, on the other hand, explains the intra-psychic phenomenon (i.e., greater differentiation) with an extra-psychic property of the ecology. For example, as the S + s is framed by the S-s (i.e., the "range" principle explained below; Alves, Koch, & Unkelbach, 2017a), the corresponding E + s must be, on average, closer together compared to the E-s. Thus, the ecological perspective of the present model invites a new level of explanations, and we will discuss these explanations below.

Empirically, we also aimed to distinguish the two approaches. For example, if positive information's differential frequency and similarity follow from an intra-psychic process due to the information's evaluation (e.g., Unkelbach et al., 2010), then one would expect valence main effects for information processing. However, we have shown several times that if positive information is more diverse and less frequent than negative information in an artificially created ecology, it enjoys the same advantages and drawbacks as negative information (for a memory example, see Alves et al., 2015; for a processing speed example, see Unkelbach, Fiedler, et al., 2008).

One may argue, though, that it is impossible to assess reality's substance, and therefore the distinction in ecological and intra-psychic causal processes is futile. There are two arguments against this objection. First, even if "substance" might not be directly accessible, it may be approximated, for example by objective measures (e.g., frequency may be counted) or by inter-rater agreements (e.g., people's agreement on similarities, see Leising et al., 2015). Second, intra-psychic explanatory constructs are typically inaccessible as well (see Watson, 1913). For example, the attitude construct is central within social psychology; yet, it is fundamentally inaccessible and it may only be assessed indirectly unless one defines a specific measure as the attitude proper. Theoretical constructs are typically not measured against the standard of empirical accessibility. To be sure, *predictions* following from causal constructs need to be empirically accessible, but the explanatory construct itself remains at the theoretical, not the empirical level. A potential criterion for the value of such a theoretical construct is that it should parsimoniously explain existing data and should allow novel testable predictions. As we will show below, the ecological approach fulfils this criterion.

In addition, the intra-psychic and the ecological perspectives are not mutually exclusive, as Table 1 may imply. The evaluation part must be subject to intra-psychic processes, even when the ecology is objectively constant (e.g., Tajfel & Wilkes, 1963, for a famous example). Rather, in our view, the most powerful implications emerge when one combines the psychological approach and its well-established cognitive processes with the assumed properties of the ecology (e.g., Hamilton & Gifford, 1976; Latané, 1981). Before we move to the implications of, and explanations for, the model's assumptions, we will review evidence for the assumed properties.

Evidence for higher frequency of positive information: good is more frequent

The EvIE's first assumed property is the higher frequency of positive information compared to the frequency of negative information. Information may refer to factual (e.g., experiences, events) or symbolic (e.g., newspaper, language) input the individual receives. Examples for positive information would be good news in the morning, the smile of a family member, the friendly "hello" of a colleague, or the pleasant experience of a warm meal. Examples for negative experiences would be bad news, a frowning face, negative feedback on an assigned task, or the unpleasant experience of a stale coffee. Again, on a meta-theoretical level, we assume factually higher frequency, and not subjectively higher frequency (see Unkelbach et al., 2010) of positive compared to negative information. That is, people will have more input that they evaluate positively rather than negatively, and not just selectively ignore, remember, or differentially process the ecological input.

The support for the frequency property is broad, and we review two sources. First, we review psycho-lexical studies, examining word frequencies in the environment. Second, we review studies examining people's affective experiences. The presented evidence for the frequency property does not build on our own research, though. In the following, unless indicated otherwise, anything we report as a difference, a correlation, or an effect was stated to be significant at least at $p < .05$ in the original research.

Psycho-lexical evidence for positive information's higher frequency

One way to test assumptions about the evaluative information ecology is based on a variant of the psycho-lexical approach in personality research. The psycho-lexical approach assumes that traits that people actually possess should be denoted in language; that is, adjectives about personalities in languages allow inferences about the structure of personality (e.g., Ashton & Lee, 2004; Goldberg, 1981). Similarly, one might assume that words people use reflect the status of the world in which people live. In other words, if positive words are more frequently used in language, this *indirectly* implies that the environment may have more frequent stimuli, interactions, and events that people evaluate positively. However, language is also part of people's reality. Thus, if words that people evaluate as positive are more frequent, it also *directly* implies that an important part of people's information ecology, namely language, is indeed marked by a higher frequency of information that people typically perceive as positive.

There are numerous studies showing a higher frequency of positive words in language. Probably the most well-known data set is within Boucher and Osgood (1969) paper on the "Pollyanna" hypothesis, named after Eleanor Porter's fictional character, Pollyanna Whittier, who strives to see only the positive in people and situations. Boucher and Osgood presented high school boys from 13 different cultures (e.g., US, India, Sweden, Afghanistan) with 100 nouns (e.g., "House", "Map", "Chair") and asked them to provide the first adjective qualifier that occurred to them. These qualifiers were then rated for their evaluative connotation and classified into positive and negative words. Across all 13 cultures, the 100 nouns elicited positive qualifiers more frequently.

While this study is frequently cited and has its strength in the intercultural diversity, its evidential value for the assumption of positive information's higher frequency is limited. A study by Augustine, Mehl, and Larsen (2011) provides more direct evidence. They used the ANEW (Affective Norms for English Words) word list by Bradley and Lang (1999). This list provides mean evaluative ratings of words on a scale from 1 (extremely unpleasant) to 9 (extremely pleasant), with 5 being the midpoint (neutral). They matched these evaluative word ratings with their frequency of occurrence, using the word frequencies reported by Kucera and Francis (1967) as well as the Hyperspace Analogue to Language (HAL) frequencies reported by Lund and

Burgess (1996). They found 1021 words for which they had both evaluations and frequencies. The average word rating in this set was close to the midpoint (M = 5.14, SD = 1.99). Across these 1021 words, higher frequencies and more positive evaluations correlated r = .18 for raw scores and r = .28 for log-scaled frequencies, which correct for frequency outliers. The correlations were identical for both frequency measures (i.e., HAL frequencies or Kucera and Francis frequencies). These correlations may appear small, yet given the sample size, they are highly significant, and given that they stem from unrelated sources and contain no shared method variance (i.e., subjective valence ratings correlated with objective frequencies), they are noteworthy: People seem to use positive words more often than negative words.

In a second study, Augustine and colleagues sampled random spoken language from 228 participants, who carried an "EAR" ("Electronically Activated Recorder; Mehl, Pennebaker, Crow, Dabbs, & Price, 2001) on two to four consecutive days. They assessed how frequently participants used words and again correlated the evaluative ratings of the uttered words. Replicating the ANEW results, frequency and valence correlated positively, r = .16.

As these are correlations, one might also assume that higher frequency makes words more positive, as in the mere exposure effect (Zajonc, 1968, 2001); frequency might breed value. This causal direction was already considered by Boucher and Osgood (1969, p. 7), and they stated two conclusions. First, when it comes to meaningful words, as in the studies we review here, the evidence for mere exposure is also only correlational. The experimental evidence builds exclusively on meaningless or unfamiliar stimuli (e.g., nonsense words, Chinese characters). Language, however, has meaning and words are familiar. Second, when it comes to meaningful stimuli, a strong prediction of the reversed causality would be that high-frequency negative words (e.g., pain, fear), should be liked better than low-frequency positive words (e.g., respect, benevolence), which seems highly implausible. Given these arguments, we subscribe to Boucher and Osgood's interpretation that higher frequency does not lead to more positive evaluations of meaningful words.

Extending the higher frequency of positive words to an even larger corpus of words, Warriner and Kuperman (2015) used a database of roughly 14,000 English vocabulary word forms. Importantly, they distinguished between *type* and *token* frequency; the former refers to the number of *unique* evaluative words in a language sample (type frequency), and the latter to the occurrences of each unique evaluative word in the language sample (token frequency). Replicating the results by Augustine et al. (2011), the authors found a correlation of r = .18 between valence and token frequency, as well as higher type frequency of positive words; 55.6% of the words in their corpus were positive. The authors concluded that:

"Together, the fact that there are more positive words (type bias) and those positive word types occur more often (token bias) leads to a large prevalence of positive words in general." (p. 1155).

Finally, Dodds et al. (2015) investigated the largest set of words so far (about 100,000) across different sources and 10 languages. They also found that the most frequently used words are positive and that all 10 languages exhibited a prevalence of positive words.

These three examples are only a small sample that illustrate how positive words are more frequent in language. And although the relative numbers and correlations may appear small, given the large samples of words, the absolute differences are substantial. In addition, the basic phenomenon is consistently found and we believe it provides good initial evidence that the EvIE is indeed marked by positive information's higher frequency.

Evidence from affective consequences for positive information's higher frequency

The psycho-lexical evidence is based on factual frequencies. Another way to provide evidence for positive information's higher frequency is based on the assumption that encountering positive information should lead to positive affective reactions (i.e., emotions and mood); again, a friend's smile, a friendly hello, or good food should lead to positive rather than negative affect. Conversely, negative information should lead to negative affective reactions; that is, a friend's frowning face, an unfriendly greeting, or bad coffee should lead to negative rather than positive affective reactions. In general, one may assume that people are happy and satisfied with their life when they have more positive experiences compared to negative experiences. More specifically, research on the "positivity ratio" suggests that people need three to five times more positive than negative affective experiences to be happy and satisfied, or to "flourish" (see Fredrickson, 2013); for example, Gottman (1994) suggests that married couples need five times more positive interactions compared to negative interactions to stay married. In turn, one may infer that people who are happy and satisfied experience more positive affect than unhappy and dissatisfied people.

Positivity prevalence within the EvIE would thus be *indirectly* supported by more frequent positive compared to negative affects, as these indicate more positive than negative information. In addition, higher satisfaction with life would indicate a substantially higher ratio of positive to negative information. And similar to the psycho-lexical evidence, a prevalence of positive emotions and moods also *directly* supports the EvIE's frequency assumption, as a positive emotion or mood also constitutes information (Schwarz, 2012).

Following this logic, strong support for the higher frequency of positive information in the EvIE comes from Diener and Diener's (1996) summary of studies reporting happiness and well-being, titled: "Most people are happy". First, the authors report data from Veenhoven, Ehrhardt, Ho, and de Vries (1993) describing happiness on a state level. Out of the 56 nations reported by Veenhoven and colleagues, 86% have a mean above 5 on a scale ranging from 0 (*most unhappy*) to 10 (*most happy*). This general happiness also extends to domains such as health, finances, and friendships, at least in the United States (Andrews, 1991). Yet, not only on a national level, but also on an individual level, positive affect seems to prevail. For example, Diener and Diener report data showing that 97% of 222 US students report positive rather than negative mood; and interestingly, the same high rate of positive affective reaction is also reported for populations that one might expect would have lower scores on variables including happiness and well-being, such as elder people and people with disabilities.

However, one-shot questionnaires might be a poor method to track properties of the EvIE based on affective reactions. There might be a general bias to report positive rather than negative states independent of the actual state. A solution for such response biases comes from experience-sampling methods to assess momentary affect (Schimmack, 2003). In experience-sampling studies of affect, participants respond across a longer time span from hours to days to weeks, at random or predetermined intervals, to mood and affect questionnaire items.

In one such study, Thomas and Diener (1990) asked 143 participants in total to respond to five negative and four positive mood items. In Study 1 (n = 40), participants responded four times a day for 3 weeks at randomly prompted occasions. In Study 2 (n = 103), participants filled out the mood measures at the end of the day for a 6-week period. In Study 1, participants reported more positive mood than negative mood at 78% of the 84 measurement points. In Study 2, participants reported more positive mood at 81% of the 42 measurement points. Thus, participants were predominantly in a good mood, suggesting that they encountered more positive relative to negative information.

In a more recent study, Brans, Koval, Verduyn, Lim, and Kuppens (2013) signalled 46 students of the University of Melbourne, Australia, to respond 10 times a day across a normal week (Study 1). Participants responded to two positive affect adjectives ("happy" and "relaxed") and four negative affect adjectives ("angry", "stressed", "anxious" and "depressed"). They rated each item on a 6-point scale from 0 (*not at all*) to 5 (*very*). Participants reported substantially higher mean Positive Affect score of 3.07 compared to their mean Negative Affect Score of 1.10. Replicating this pattern with a student sample from the University of Leuven in Belgium in Study 2, the authors report the same pattern. With a slider measure from 0 (not at all) to 100 (very much), participants reported much higher positive affect ($M = 57.26$) compared to negative affect ($M = 15.65$).

These three studies are only a small selection of many studies that show this pattern. The proposed positivity prevalence is so apparent that most studies do not even report it; for example, a widely cited paper by Csikszentmihalyi and Hunter (2003), who tracked the mood of over 800 high school students, does not even report the absolute values of happiness, but only the changes in happiness (i.e., the general happiness is assumed). Thus, while there might be a bias to report more positive than negative affective reactions in hindsight, evidence from experience-sampling studies with typically much smaller reporting biases also shows the proposed positivity prevalence. If one allows that affect is based on the organism's reactions to incoming information and there is congruence between the incoming information's evaluation and the following affect (i.e., positive information leads to positive affect), then the reported data strongly suggest that the EvIE is marked by a higher frequency of positive information. Even further, if one accepts mood and affect as types of information (Schwarz, 2012), then these studies provide direct evidence for the suggested frequency property.

Summary of the evidence for positive information's higher frequency

We proposed that good is more frequent than bad. This proposition is widely shared in the literature. To support the proposition, we presented psycho-lexical evidence and evidence from affective consequences. The former assumes that language should to some degree reflect reality. The latter assumes that positive information should lead to positive emotional experiences, and negative information should elicit negative emotional experiences. In both cases, there is strong support for the proposed higher frequency of positive information.

There are also other indicators for the assumed higher frequency of positive information; for example, people's tendency to evaluate others positively rather than negatively (e.g., Rothbart & Park, 1986), and the fact that people expect others to behave positively (Sears, 1983). Thus, the converging evidence, especially from large-scale investigations of language and affect, suggests that there is indeed more positive than negative information in the evaluative information ecology.

Evidence for higher similarity and lower diversity of positive information: good is more alike

The EvIE's second assumed property is that positive information is more similar and less diverse compared to negative information. Compared to the frequency property, the similarity/diversity property has received much less attention. One reason for this differential attention in research is that frequency can be easily assessed and calculated, but assessing similarity between stimuli, especially with larger stimulus sets, is a time-consuming and costly endeavour. There is nevertheless good evidence for the proposed higher similarity and lower diversity of positive information in the EvIE.

We structure this part similar to the evidence for the higher frequency of positive information. We first present a psycho-lexical argument: there is a more varied vocabulary available for negative compared to positive information. Then, we will argue that there is more differentiation on the side of emotional reactions. However, we restrict ourselves to a shorter review of this literature, compared to the frequency review, as we will follow up with recent work from our own research group that directly investigated the differential similarity of positive and negative information.

Psycho-lexical evidence for positive information's higher similarity and lower diversity

As argued above, if language contains more differentiation on the negative side, then the EvIE should also be more varied on the negative compared to the positive side. And while such evidence suggests indirectly that the EvIE may have more variations of negative events and interactions, it also provides direct evidence. Parallel to our frequency argument, language is part of the EvIE, and if language is more diverse on the negative side, this directly supports the EvIE's similarity/diversity property.

The most basic evidence follows logically from Clark and Clark (1977), who argued that across languages, evaluative dimensions are usually defined by the positive pole. For example, the strong–weak dimension would be the *strength* dimension, and the happy-sad dimension would be the *happiness* dimension, rather than the weakness or the sadness dimension, respectively. They argue that positive states represent the normal, expected, in linguistic terms, the "unmarked" state of the world (hence the dimension labelling), while negative states are the marked state (see Bybee, 2010, for a discussion of the markedness concept). Beyond dimension labelling, native speakers experience the markedness phenomenon on many levels. For example, it feels correct to write about "positive and negative information", however, the reverse "negative and positive information" feels somehow off and incorrect. In language, positivity is the norm and comes usually first. As a further illustration, Clark and Clark provide the example of milk. The unmarked concept of milk (i.e., milk without a qualifier) is positive, while the marked state is negative. "Milk" is by default understood to be "good milk", while the negative state "bad milk" needs to be communicated as the deviation from the default, unmarked state. In addition, the deviation may be in the direction of bad milk, sour milk, or putrid milk. Thus, while language encodes positive states as the unqualified norm, there are multiple marked negative states, leading to greater diversity for negative information in language.

Negative information's greater diversity in language then also follows for evaluative adjectives. It is possible in most languages to go from an unmarked positive state to a marked negative state (e.g., from "happy" to "unhappy"), but typically not the other way around (e.g., from "sad" to "unsad"). Thus, there are more negative ("unhappy", "sad") than positive ("happy") adjectives, and the diversity of negative (vs. positive) information in language should consequently be higher.

This theoretical assumption about language is also supported empirically. For example, Leising, Ostrovski, and Borkenau (2012) asked participants to describe five targets "using terms of their own choice", for targets they know well and for targets they know less, and orthogonally, for targets they liked and disliked, as well as for the self. They coded how many terms people used and how many distinct terms they used; for example, if Participant 1 uses the terms *nice, friendly*, and *helpful* to describe a target she knows well and likes, and Participant 2 uses the terms *nice, attractive*, and *helpful* to describe such a target, the result would be 6 (how many) and 4 (how many distinct), respectively. The results showed a much lower number of distinctive terms on the positive side. For well-known targets, participants used more terms to describe liked targets (n = 780) compared to disliked targets (n = 618); however, despite higher frequency, participants described the liked targets with fewer distinct terms (n = 253) compared to the disliked targets (n = 317). Thus, participants' proportion of distinct terms to describe liked targets was much smaller compared to the proportion of distinct terms to describe disliked targets (32.4% vs. 51.3%). The same was true for less known targets. Participants used more (n = 592) but less unique (n = 192) terms to describe liked targets, and fewer (n = 558) but more unique (n = 263) terms to describe disliked targets, resulting in a similar difference of proportions (32.4% vs. 47.1%; for conceptually similar results, see Leising, Erbs, & Fritz, 2010).

However, one study showed that there might be more differentiation on the *positive* side. Warriner and Kuperman (2015), who also reported a higher token frequency of positive words discussed above, reported a higher type frequency. Of all the 13,951 *unique* words in their database, 55.6% were above the scale midpoint. This implies more differentiation on the positive side. At first sight, this is at odds with the reported psycho-lexical evidence for negative information's higher diversity so far. We believe the reason for the inconsistency is the sampling direction. Due to the overall higher frequency of positive information, unconditional sampling of all words as in the Warriner and Kuperman data set, also including words such as "chair" or "street", will lead to a skew in the distribution towards positive information and this will spill over to more positive items having a unique representation in language. If overall more words in language are positive, more unique words will also be positive. However, given one sample's positive and negative information equally, as Leising et al. (2012) did by having participants describe both liked and disliked targets, the higher similarity of the positive information relative to negative information becomes apparent. Another way to correct for the positivity prevalence in language is to assess the proportion of unique positive and negative information relative to the overall amount of positive and negative information in a given sample, as done by Leising et al. (2012, p. 395), yielding higher diversity on the negative side.

Evidence from affective consequences for positive information's higher similarity and lower diversity

Parallel to our frequency argument, one may assume a greater diversity within the EvIE when there is greater diversity of potential affective reactions. Again, the indirect evidence would assume that if the EvIE is more differentiated on the negative side, then affective reactions should also be more differentiated. The direct evidence would assume that emotional experiences are also informational input and thereby part of the evaluative information ecology.

The strongest evidence for greater diversity of negative emotions is found in theories of basic or fundamental emotions (see Izard, 2009, for an overview). Ortony and Turner (1990) provided a list of 12 literature sources that postulated basic emotions. Table 2 shows a conceptual reordering of their table (p. 316).

As Table 2 shows, for classic theories of basic emotions, which were not selected by us, but by an unbiased source, no theory assumes more positive than negative emotions, two assume an equal amount, and 11 assume *more* basic negative emotions. On average, the theories postulate three times more negative compared to positive emotions. Assuming that emotional reactions are specific to a given stimulus and the organism with its needs, goals, and resources, the higher diversity of negative basic emotions is in line with the idea that the EvIE is characterised by a greater diversity of negative information.

Direct assessments of similarity

Again, the similarity or diversity of evaluative information has received much less attention in the literature compared to evaluative information's frequency. This might be partially due to the greater effort necessary to assess similarity compared to frequency. The gold-standard for similarity assessment is pairwise comparison ("How similar is A to B?"). For larger stimulus sets, this method becomes time-consuming; to assess the similarity of N stimuli, one needs $C = N \times (N-1)/2$, with C being the number of

Table 2. A list of authors who enumerated basic positive and negative emotions. The columns state the named positive, negative, and ambivalent emotions and the absolute frequency of the three emotion classes within each list of "basic" emotions.

Source	Positive emotions	Number of positive emotions	Negative emotions	Number of negative emotions	Ambivalent emotions	Number of ambivalent emotions
Arnold (1960)	courage hope love	3	anger aversion dejection despair fear hate sadness	7	desire	1
Ekman, Friesen, and Ellsworth (1982)	joy	1	Anger disgust fear sadness	4	surprise	1
Gray (1982)	joy	1	rage terror anxiety	3	-	0
Izard (1971)	joy	1	anger contempt disgust distress fear guilt shame	7	interest surprise	2
James (1884)	love	1	fear grief rage	3	-	0
McDougall (1926)	elation tender-emotion	2	anger disgust fear subjection	4	wonder	1
Mowrer (1960)	pleasure	1	pain	1	-	0
Oatley and Johnson-Laird (1987)	happiness	1	anger disgust anxiety sadness	4	-	0
Panksepp (1982)	-	0	fear rage panic	3	expectancy	1
Plutchik (1980)	acceptance joy	2	anger disgust fear sadness	4	anticipation surprise	2
Tomkins (1984)	joy	1	anger contempt disgust distress fear shame	5	interest surprise	2
Watson (1930)	love	1	fear rage	2	-	0
Weiner and Graham (1984)	happiness	1	sadness	1	-	0
Mean		1.23		3.69		0.77

Note: The complete references are in the reference list, cited after Ortony and Turner (1990).

comparisons. If one aims to balance comparison order ("A compared to B" vs. "B compared to A", see Tversky, 1977), one needs $C = N\times(N-1)$ comparisons. Thus, similarity assessments of larger stimulus samples quickly reach very high numbers of comparisons (e.g., 50 positive and negative items require 4950 comparisons, without balancing comparison direction).

Within our research group, we nevertheless aimed to directly assess the differential similarity of positive and negative information. We used the standard methods of pairwise comparisons as well as the novel method of spatial arrangement. For the former method, as stated, participants make pairwise ratings of how similar information is; for example, how similar are "pretty" and "kind", and how similar are "ugly" and "nasty". Differential similarity in line with our ecological assumption implies that people should rate the positive word pairs as more similar compared to the negative word pairs. For the spatial arrangement method, participants would see the four words on the computer screen with the task to arrange them according to their similarity (Hout, Goldinger, & Ferguson, 2013; Koch, Alves, Krüger, & Unkelbach, 2016). The differential similarity would be apparent if the distance between positive information arranged on the screen would be smaller compared to the distance between the negative information. Figure 1 illustrates examples of these methods.

Unkelbach, Fiedler, et al., (2008) provided the first direct evidence for the differential similarity of positive and negative information. In their study, participants made pairwise similarity comparisons of 20 positive words (e.g., "butterfly", "movies", "cake") and 20 negative words (e.g., "bombs", "virus", "garbage") that were frequently used in social psychological research (e.g., Bargh, Chaiken, Govender, & Pratto, 1992; Fazio, Sanbonmatsu, Powell, & Kardes, 1986). The resulting 780 pairings were randomly split into 390 comparisons per participant. The authors computed a multidimensional scaling solution based on the resulting similarity matrix of participants' averaged similarity responses. Multidimensional scaling orders the stimuli in a dimensional space based on participants' similarity ratings. In this space, the distance between stimuli can be seen as the inverse of similarity

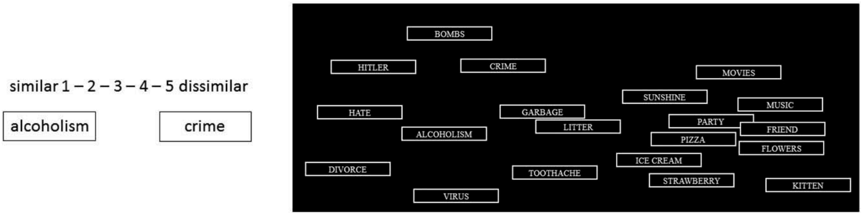

Figure 1. The left panel shows a trial from a pairwise similarity assessment study. The right panel shows a screenshot from a spatial arrangement study.

(Krumhansl, 1978). Unkelbach and colleagues then computed the average distance within the cluster of positive information and the cluster of negative information. The data showed that the 20 positive stimuli clustered much more densely in the multidimensional space compared to the 20 negative stimuli; this pattern remained stable when varying the number of dimensions and when accounting for outliers in the multidimensional space. Table 3 provides an overview of the average distances within each valence cluster, with higher distances denoting lower similarity. The table shows that dimensionality increases the overall distance. However, independent of the dimensionality, positive stimuli are more densely clustered compared to negative stimuli.

Using the same methodology, this pattern was replicated by Bruckmüller and Abele (2013) for 40 positive/negative trait words, and by Unkelbach, Guastella, and Forgas (2008; unpublished secondary analysis) for 60 words relating to sex and relationships.

Obviously, even across different stimulus sets, the information sample is still restricted, in particular when compared to the large data sets available for frequency estimates of positive and negative information. As stated above, the main challenge is the high number of ratings participants must deliver if one uses pairwise comparisons. Koch, Alves, et al., (2016) provided a solution to this problem. Building on the discussed spatial arrangement method by Hout et al. (2013), their participants arranged stimuli on the computer screen and with distance on the screen construed as the inverse of similarity.

Koch, Alves, et al., (2016) used this fast and efficient similarity assessment method to test large samples of information. Study 1 was a replication of Unkelbach, Fiedler, et al.,(2008) Study 2 using the SpAM method; the correlation between pairwise comparison similarity and SpAM similarity across 20 positive and 20 negative words was $r = .84$, indicating the validity of the SpAM method. Given this high correlation, they also replicated the differential similarity of positive and negative information. In Study 2a, 46 participants generated their own 20 positive and 20 negative words to provide an

Table 3. Average distances within each valence cluster of 20 positive and 20 negative stimuli as a function of dimensionality of the MDS solution (from Unkelbach, Fiedler, et al., 2008).

	MDS-solution		
	Two-dimensional	Three-dimensional	Four-dimensional
Positive stimuli	4.29 (1.00)	8.31 (1.59)	13.38 (1.92)
Negative stimuli	5.39 (1.17)	10.55 (1.83)	16.36 (2.29)
t	3.20	4.13	4.42
p <	.01	.001	.001

Note: Standard deviations are shown in parentheses; smaller distances indicate higher similarity. The *p*-values indicate the probability of the *t*-value associated with the distance difference between the two valence groups.

unrestricted, maximally variable, and a large sample of words. After generating the words, participants spatially arranged them. Participants in this study generated 1044 words, and across all stimuli, participants arranged positive words closer together compared to negative words. To show that this effect is consensual, another yoked sample of participants (Study 2b) arranged the stimulus sets generated by participants from the previous study. Again, participants arranged the positive words significantly closer on the computer screen compared to the negative words (see Figure 2).

To further address the possibility that the higher perceived similarity is a phenomenon of consensus about positive information (see Leising et al., 2012), Koch, Alves, et al. (2016) asked another sample of participants to generate words that are positive and negative either idiosyncratically (i.e., "for you personally"; Study 3a), or consensually (i.e., "for all people"; Study 3b). Showing the success of the manipulation, participants in the idiosyncratic condition generated significantly more unique positive and negative words (n = 1,139) compared to the consensual condition (n = 995). Independent of whether words were generated consensually versus idiosyncratically as positive/negative, participants arranged the positive words much closer together compared to the negative words (see Figure 2).

Study 4 addressed the possibility that the generation process is responsible for the similarity pattern. Retrieving positive words from memory may induce a more positive mood, which fosters inclusive rather than exclusive thinking styles (Bless & Fiedler, 2006; Forgas, 2008), which may lead to biased samples

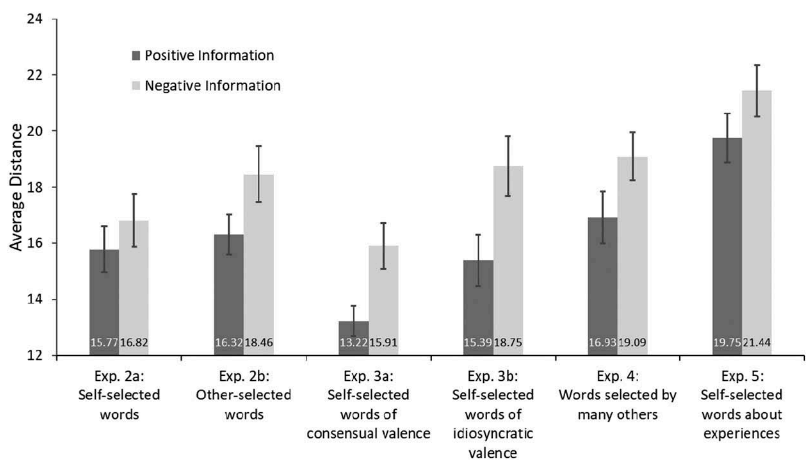

Figure 2. Summary of the similarity data from Koch, Alves, and colleagues (2016; Exp. 2–5). The y-axis shows the average distance with higher distance indicative of lower similarity within a given valence. Within each experiment, positive information is significantly more similar compared to negative information. Error bars show the standard error of the means.

from memory. To illustrate this, a participant sampling positive information may think of "love", then inclusively generates "partner", then "children", then "warmth", and so forth. The same participant sampling negative information may think of "war", but stops to think about war, and generates "dirt" (instead of bombs), and then "lie" (instead of "stink"), and so forth. To exclude this possibility of biases in the sampling process, a sample of participants first generated a single positive word and a single negative word; as each participant generated only a single word, there can be no bias during generation. Then, a second sample spatially arranged a random sample from the unique stimuli generated by the previous sample. As before, participants clustered the positive words closer together compared to the negative words (see Figure 2).

So far, these studies relied on freely retrieved words as stimuli in a single experimental session. Going beyond that, Koch and colleagues (Study 5) employed an event-sampling approach. They collected data from 124 participants; these participants recorded one positive and one negative event of the day over the course of a week. At the end of the week, participants spatially arranged the collected events according to their subjective similarity. As for the generated words, participants arranged their positive events closer together compared to the negative events (see Figure 2).

In a last study, Koch, Alves, et al., (2016) extended the asymmetry in similarity to large samples of words and pictures by using the 13,915 words in the database by Warriner, Kuperman, and Brysbaert (2013) and 956 pictures from the International Affective Picture System (IAPS; Lang, Bradley, & Cuthbert, 2005). Importantly, the stimuli in these samples have ratings on three dimensions of valence, arousal, and dominance/potency (Osgood, Suci, & Tannenbaum, 1957). Thus, one may compute the location of each stimulus in a three-dimensional space of valence, arousal, and potency and assess the distance as a function of valence. Figure 3's top panel illustrates the spatial similarity for the words in the dataset by Warriner et al. (2013), and Figure 3's bottom panel illustrates the spatial similarity for the pictures within the IAPS (Lang et al., 2005). Both for the large samples of pictorial as well as the verbal stimuli, positive information was located much closer together compared to negative information (Koch, Alves, et al., 2016; Study 6).

Summary of the evidence for positive information's higher similarity and lower diversity

We proposed that good is more alike than bad. Assuming again that language should to some degree reflect reality, we provided psycho-lexical evidence that the vocabulary for positive information is more similar and less diverse compared to the vocabulary for negative information. In addition, assuming that different information in the environment should lead to different

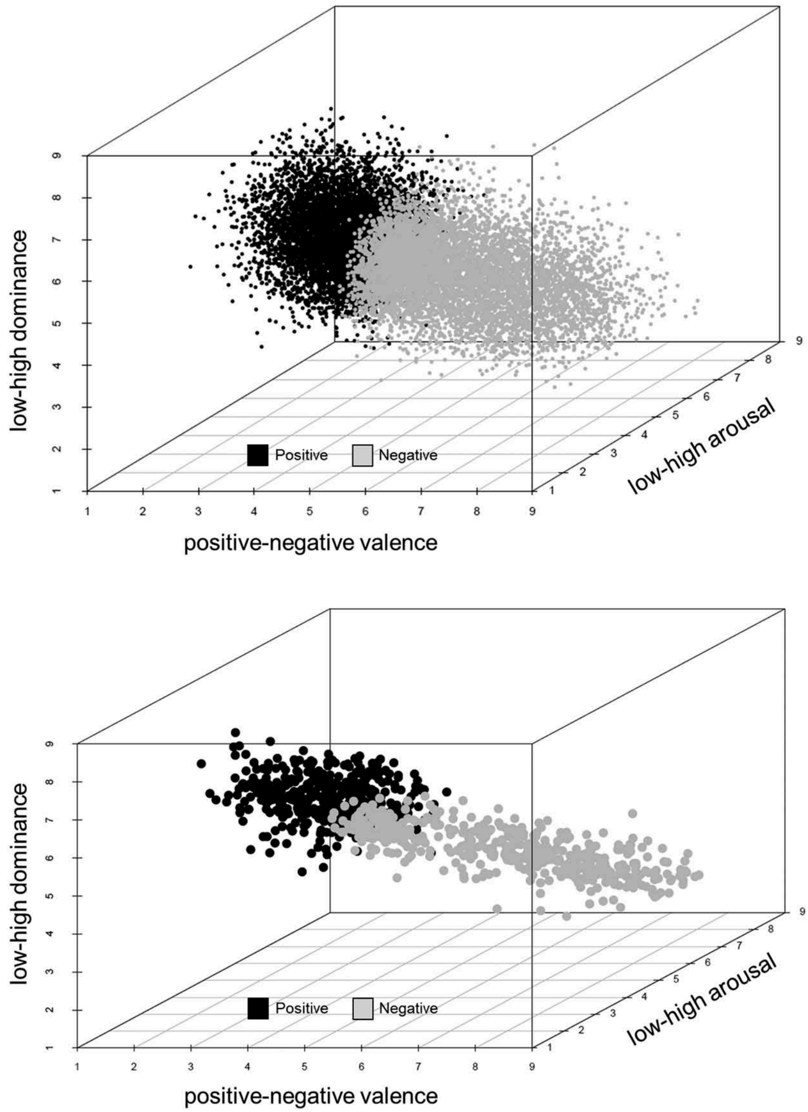

Figure 3. Three-dimensional distances of large stimuli sets. The top panel shows the 13,915 words used by Warriner et al. (2013), as a function of valence, dominance, and arousal. The bottom panel shows the 956 IAPS pictures used by Lang et al. (2005), as a function of valence, dominance, and arousal. As both illustrations show, positive information clusters more densely compared to negative information.

emotional experiences, and similar information should elicit similar emotional experiences, we provided evidence from affective responses, namely the higher number of negative "basic" emotions. As far as one considers emotions also as information, this also shows directly the higher diversity of negative information. Finally, we provided direct evidence from our own research group that showed, by means of pairwise comparisons and spatial arrangement, that people see positive words, pictures, and events as more similar and less diverse compared to negative words, pictures, and events. In combination, these data provide strong support for the proposed differential similarity and diversity of positive and negative information in the EvIE.

Explanations for the structural properties of the evaluative information ecology model

Having presented evidence that the EvIE is marked by higher frequency and similarity of positive information, we now outline potential reasons for these properties. Distinct from the evidence presented thus far, these explanations are not based on empirical work, but on *a priori* assumptions and theoretical delineations, as experimental tests for causes of ecological variations are difficult to implement.

Higher frequency of positive information

Higher frequency of positive information following from evolutionary necessities

First, positive information should be prevalent in people's information ecologies, building on the principle that social life which organises itself cooperatively rather than competitively has survival advantages (Axelrod & Hamilton, 1981; Hardin, 1968). In their seminal paper, Axelrod and Hamilton stated that, "Many of the benefits sought by living things are disproportionally available to cooperating groups. [...] this statement, insofar as it is true, lays down a fundamental basis for all social life." (p. 1391). To support this statement, Axelrod and Hamilton used the "prisoner's dilemma", an economic game in which two players may either cooperate or defect to achieve desired outcomes (i.e., points or money). It is a dilemma game because for both players, the strategy with the highest expected outcome is defection. Yet, if both players defect, both sides lose. The authors used this game to illustrate two points. First, within a single interaction, defection is indeed the most advantageous behaviour for both players. Second, if the probability of future interactions increases, as is the case in most human interactions, cooperation becomes more advantageous. And this cooperation strategy was proven to be robust (i.e., it has advantages compared across environments in which other players use other strategies), to be stable (i.e., it resists competing strategies once it is established), and initially viable (i.e., it emerges even in environments that are predominantly non-cooperative).

Assuming that most people experience cooperative behaviour as positive and defective behaviour as negative, it follows that social life with evolutionary advantages provides predominantly positive experiences. Single individuals may show defection; that is, they may show negative behaviour. Yet, on a species or societal level, cooperation, that is, positive experiences, should be dominant and therefore more frequent (Sally, 1995).

A similar result is visible in another economic game, the "trust" game that involves two randomly paired players (Berg, Dickhaut, & McCabe, 1995). One player is assigned the role of *sender*, the other the role of *receiver*. The sender is endowed with a fixed amount of money (e.g., $10). Then, the sender decides how much money x to send; given an endowment of $10, x may vary between $0 and $10. The sender then keeps $10–x and the experimenter doubles or triples the amount passed to the receiver (e.g., x*3). The receiver then decides how much of x*3 to return to the sender. The passed value x captures trust in the sense of "'a willingness to bet that another person will reciprocate a risky move at a cost to themselves'" (Camerer, 2003, p. 85). The negative (and potentially rational) move for the sender would be to simply keep the endowment. However, in a meta-analysis of 161 studies with 23,924 people, Johnson and Mislin (2011) report an average proportion (i.e., ranging from 0 to 1) of the endowment to be sent of $M = 0.50$ ($SD = 0.12$), with a minimum mean of 0.22 and a maximum mean of 0.89. Thus, people chose to trust on average and show the positive behaviour of sending part of their endowment to the receiver, at a cost to themselves. Within each study, there might be participants who do not send anything, but on average, all studies show trusting and thereby positive behaviour.

The idea that positive interactions and thereby positive information are prevalent may clash with lay notions that the world is a harsh and bad place. One potential reason for the negative outlook is that subjective memory also favours negative information due to its infrequency and distinctiveness (Alves et al., 2015). For example, people will remember non-cooperative behaviour or the breach of trust in a relationship better than the normative cooperative behaviour or the simple continuation of a trustful relationship. This subjective impression may actually follow from our assumptions about the EvIE.

However, even if one does not subscribe to this abstract interpretation of the social environment and doubts the prisoner's dilemma or trust games as a model of social behaviour, there are other factors that should lead to positive information's higher frequency.

Higher frequency of positive information following from reinforcement learning

Starting with very young children, most people, and parents in particular, sanction negative behaviours and reinforce positive behaviours; that is, behaviours that they experience as positive. As people should repeat reinforced behaviours, as in Thorndike's "law of effect" (1898), positive behaviours should be more prevalent than negative behaviours. This reinforcement of positive behaviours is not restricted to parent–child interactions, but is also apparent in teacher–student interactions, or in peer-to-peer interactions. In addition, acting and interacting in positive ways also promotes favourable evaluations, relatedness, belonging to others (Langston, 1994; Reis et al., 2010), and life satisfaction (Lyubomirsky, Sousa, & Dickerhoof, 2006). Thus, because behaviours that others experience as positive are reinforced on many levels, "positive" behaviours should be more frequent, and people's EvIE should be marked by the frequency of behaviours they experience as positive.

If one considers the "why" of such reinforcement patterns, one explanation is again evolutionary pressure that translates into cultural and behavioural norms. The "law of effect" explanation and the evolutionary necessity explanation are therefore not independent, but located at different explanatory levels. The evolutionary explanation for positive information's higher frequency is located on a phylogenetic level, that is, learning on a species level by selection pressure on the gene pool. The law of effect explanation is located on an ontogenetic level; that is, learning on an individual level by reinforcements from the environment.

Higher frequency of positive information following from hedonic sampling

The two previous explanations conceptualise people as passive recipients of evolutionary pressures or learning experiences. However, the higher frequency of positive information also emerges when one considers people as active agents who follow individual needs and goals. This agentic pursuit also leads to the higher frequency of positive information if one accepts that people follow a hedonic principle; they should seek pleasure and avoid pain, a utilitarian principle postulated by Jeremy Bentham (1996; originally published, 1789). Thus, the higher frequency of positive information follows because people sample their information hedonically; they approach positive experiences (i.e., people, events, stimuli), and avoid negative experiences (Denrell, 2005; Fazio, Eiser, & Shook, 2004). If free to choose, people are more likely to repeatedly meet up with people who have positive traits, who are in positive states, and who act in a positive way (e.g., their partners, friends, and acquaintances). People are also more likely to repeatedly take part in positive events such as their favourite hobbies, entertainments, and vacations. And people are more likely to repeatedly make use of food, clothes, vehicles, and other kinds of consumer products that they evaluate as positive.

While this hedonic sampling principle explains a number of social phenomena by itself (Denrell, 2007; Denrell & Le Mens, 2007), its immediate corollary is that even in an ecology with an equal base-rate probability of positive and negative information (i.e., if Table 1's right part is false), people's EvIE should still show a higher frequency of positive information, as the sampling process is not random, but hedonically geared towards positive information.

Summary of explanations for positive information's higher frequency

We suggest three overlapping explanations for positive information's higher frequency in people's EvIE. First, it follows because cooperative (i.e., positive) behaviours have an evolutionary advantage. Second, it follows because positive behaviours are reinforced. And third, it follows because people actively seek positive rather than negative interactions and experiences. These explanations may independently or jointly contribute to the higher frequency of positive information. And consequently, relating back to the evidence for the EvIE's frequency property, language describing these positive interactions and experiences, as well as positive affective reactions resulting from these interactions and experiences should be more frequent.

Higher similarity and lower diversity of positive information

Explaining the relative higher similarity/lower diversity of positive information is less straightforward compared to the explanations for its higher frequency. Cardinal frequencies may be objectively assessed, while one may argue that, similar to valence, similarity does not exist without a person to construe the similarity, and there is a long-lasting debate about the correct conceptualisation of similarity (e.g., Goldstone & Son, 2005; Goodman, 1972; Medin, Goldstone, & Gentner, 1993). While we would agree that similarity is indeed more subjective than frequency, and our first argument follows from subjective similarity, we will also argue that there is an empirical basis for the differential similarity of positive and negative information. That is, it is not only a subjective processing outcome, but also an objective feature of the ecology.

Higher similarity following from co-occurrences

The first explanation builds on the assumed higher frequency of positive information. Any positive information that occurs more frequently must also *co-occur* more frequently. Let us illustrate this for the area of person perception. For example, let the probabilities of acceptable extraversion and emotional stability be $p = .70$ – that is, 70% of all people are in a "good" range of extraversion and emotional stability, while there is $p = .15$ of "too much" and $p = .15$ of "too little" extraversion and emotional stability. For simplicity, let both traits be independent. The probability that a person is both normally extraverted and emotionally stable is then $p = .70 * .70 = .49$. Conversely, the probability that a person is excessively extraverted and excessively emotionally stable is only $p = .15 * .15 = .0225$, and the same goes for the probabilities of being insufficiently extraverted and insufficiently emotionally stable, excessively extraverted and insufficiently emotionally stable, and insufficiently extraverted and excessively emotionally stable. Given these assumed values, the co-occurrence of the two positive quantities is about 20 times more likely than each of the four different co-occurrences of negative quantities. Thus, if positive information occurs more frequently, it also co-occurs more frequently.

Differential frequency of co-occurrence then directly translates into similarity, as the frequency of co-occurrence leads to subjective inter-stimulus similarity (e.g., Cilibrasi & Vitanyi, 2007; Griffiths, Steyvers, & Tenenbaum, 2007; Jones & Mewhort, 2007). Stimuli that co-occur more frequently in space and time are more strongly associated in memory (Fiedler, Kutzner, & Vogel, 2013; Verhaeghen, Aikman, & Van Gulick, 2011). For example, people in the US judge the words "Vikings" and "Minnesota" as similar, just because they co-occur frequently, despite the fact that the concepts share no physical or conceptual features at all; yet, the football team "Minnesota Vikings" creates frequent co-occurrences. Thus, given that positive information co-occurs more frequently, people should represent positive objects, people, and events as more similar to one another than their negative counterparts. Higher *subjective* similarity directly follows from a higher frequency.

Higher similarity following from the range principle

Similarity derived from co-occurrence is based on subjective perception. Yet, subjective similarity may also be based on objective, physical features. Everything else being equal, a line with a length of 2 cm is "more similar" to a line of 1 cm compared with a line of 10 cm. Likewise, the colours red and yellow are more similar than red and blue, as the former pair has more similar frequencies within the light spectrum compared to the latter one. If one accepts this notion of similarity, there is a basis for objective similarity that does not depend on subjective construal.

In line with Lewin (1939), we defined valence as the result of the interaction of a given attribute or feature with the goals and needs of the organism. As we have argued, based on Leising et al. (2015), these attributes or features may have a "substance" manifestation. For example, temperature is a feature of the environment. Yet, human life is only possible within a very narrow temperature range; most of the temperature scale is "too hot" or "too cold" for humans. The same goes for other physical attributes such as oxygen levels or UV radiation. The "good" range that meets the needs of human life is framed by "too much" or "too little". If one accepts this range principle, that on a given dimension such as temperature or UV radiation a middle range typically meets the needs of an organism, then the higher similarity within this "positive" range follows (Alves et al., 2017a). For example, any two randomly drawn "positive" states (i.e., temperatures that humans experience as pleasant) on the temperature dimension will be on average more similar than two randomly drawn negative states (i.e., temperatures that humans experience as unpleasant), just because the single positive range is framed by two negative ranges, which are typically unrestricted (i.e., hot, very hot, too hot, etc.). The higher similarity within the positive range will increase if more than one dimension is considered. For example, if one takes two dimensions (e.g., temperature and humidity) with one positive middle-range each into account, there is only one positive area (middle warm/cold with middle humid/dry), but there are four clearly negative areas (too dry–too hot, too humid–too hot, too dry–too cold, and too humid–too cold) and four combinations of positive/negative variations. If one plots this on a continuous level, the narrow range and the resulting higher similarity/lower diversity of positive states becomes apparent (see Figure 4). We already applied this range principle in Table 1's ecological right side, where the two S+ instances are framed by two S- instances.

To be precise, the range argument does not simply state that positive states are narrower and therefore more similar. The range argument's core is the assumption that the positive range is in the middle of the dimension and not at the extremes (i.e., not "too much" and not "too little"). In fact, the breadth of what people experience as positive on a given dimension can be wider than the breadth of what people experience as negative. Yet, as long as the positive

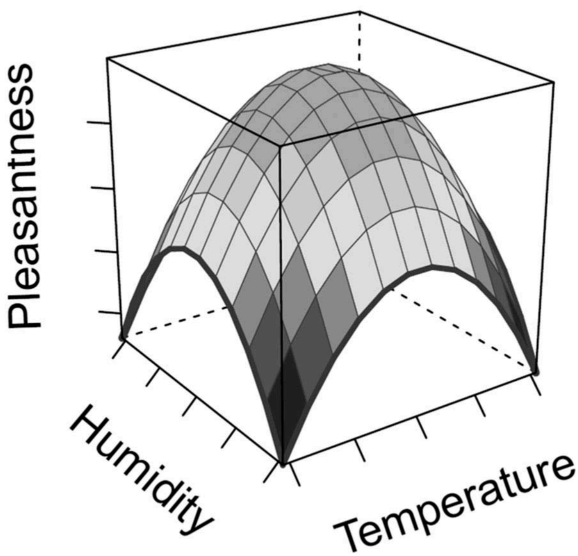

Figure 4. Illustration of the range principle with experienced pleasantness as a function of temperature and humidity. For both humidity and temperature, there is a positive middle range which is framed by too cold/too warm and too dry and too wet, respectively. The result is a narrow area of pleasant experiences within average levels of humidity and temperature.

range is framed by two negative ranges of “too much” and “too little”, the range argument is valid. And the higher similarity of positive stimuli is amplified by the combination of different substance dimensions that determine what is likeable, agreeable, or in general positive.

Importantly, the same is true for social attributes that are not directly based on physical features. This was already discussed by Aristotle who stated that desirable character qualities are modest qualities which are framed, at each end, by excess (“too much”) and deficiency (“too little”). People may be too talkative or too quiet, too outgoing or too reclusive, or too courageous or too cowardly. In virtually all human attributes, the positive range is non-extreme (Grant & Schwartz, 2011; Williams & Simms, 2018), and the proposed curvilinear relationship is consistently found in the social domain (e.g., Imhoff & Koch, 2017; Koch, Imhoff, Dotsch, Unkelbach, & Alves, 2016).

Probably the most vivid example of the range principle is facial beauty. Faces are made up from a high number of attributes (e.g., Todorov, Dotsch, Porter, Oosterhof, & Falvello, 2013). For a face to be “beautiful”, these attributes must lie in the middle of the dimension. Noses might be too big or too small, eyes too far apart or too close together, chins too prominent or too feeble. In short, as predicted by the range principle, people prefer facial attributes that are in the middle of the distribution (Potter, Corneille, Ruys, & Rhodes, 2007; Rhodes, 2006).

The only exceptions are attributes and features that are first derivatives from “substance” – that is, features that already include evaluations. The most obvious case would be the dimension of “goodness”; more of the “good” dimension can by definition not be worse than less of it. Another example is money, which is, particularly in economic games, seen as an unconditionally “good” thing. Nevertheless, one might even argue here that people might experience too much “good” or that too much money will make people unhappy. Although if the experiential side is considered, the idea that “fewer good feelings” feel better than “more good feelings” leads to a paradox. Yet, as long as the substance of the environment is concerned and not its evaluation (see Leising et al., 2015), the range principle will be valid.

Higher similarity following from affective influences

A final potential explanation follows if one assumes that positive information immediately leads to positive affect, which in turn leads to differential processing of positive and negative information; that is, positive information may seem more similar due to the differential processing elicited by the respective affect (Topolinski & Deutsch, 2013). Building on standard models of affect and cognition interactions (Bless & Fiedler, 2006; Forgas, 2008), this is a viable explanation. Importantly, the EvIE’s similarity property would then not be an ecological property, but a processing outcome. This would not change the subjective nature of the EvIE, but an affective explanation would shift the similarity property from an ecological to a psychological explanation (see Table 1).

To test this alternative, Alves, Koch, and Unkelbach (2019) directly compared the impact of affect on perceived similarity in five experiments, using the same manipulations as Topolinski and Deutsch (2013). Contradicting an intra-psychic explanation of similarity, Alves and colleagues found no influence of affect on the perceived similarity of stimuli (for a similar null effect of mood on the perceived similarity of groups, see Stroessner & Mackie, 1992). While there are undeniable influences of affect on cognitive processes, similarity assessments such as pairwise comparisons and spatial arrangements seem to be independent of these influences.

Summary of explanations for positive information's higher similarity/lower diversity

We suggested two explanations for the higher similarity/lower diversity of positive information. First, a higher frequency of positive information must lead to the higher co-occurrence of positive information with other positive information, relative to the co-occurrence rates of negative information. The ecologically more frequent co-occurrence then leads to the higher subjective similarity of positive information. Going beyond this subjective similarity, we also argue that positive information is objectively more similar, based on the range principle (Alves et al., 2017a). As any attribute or feature (i.e., substance) dimension frames the "positive" range by the excesses of "too much" and "too little", the higher similarity and lower diversity of positive information follows. As with the explanation for the frequency property, these two explanations may contribute independently or jointly to differential similarity/diversity. In addition, affective influences may contribute to information's similarity and diversity; however, direct tests of this assumption showed no support for this explanation of the differential similarity and diversity of positive and negative information.

Implications

So far, we provided evidence and explanations for the higher frequency of positive information relative to negative information (i.e., traits, experiences, behaviours), and the higher similarity of positive information to other positive information. In the remainder, we aim to back up our claim that the interaction of these properties with well-established social-cognitive principles within the organism may lead to the discovery of novel phenomena and alternative explanations for classic social psychological findings. We will address halo effects, the relation of similarity and liking, the relation of frequency and liking, as well as the field of intergroup biases. In the following review of our empirical findings, anything that is reported as a difference is significant (i.e., probability of the test statistic under the H_0 is $p < .05$), unless indicated otherwise; all reported experiments had proper power considerations and reported all conditions, all data exclusions, and all variables. In addition, we predicted the empirical findings from the assumed properties and did not derive the EvIE's properties from these studies; thus, the following experimental work supports the EvIE as a general model for people's social reality.

Halo effects: being honest makes you industrious, but lying does not make you lazy

Halo effects are among the best-established findings in psychology. Thorndike (1920) coined the term when he observed a "constant error in psychological ratings": When army officers were evaluated by their superiors, theoretically independent dimensions constantly correlated more highly than they should. Thus, raters either used information on one dimension to rate another dimension or made inferences from a global impression about the to-be-rated target (Cooper, 1981). Probably the most famous halo effect is from ratings of physical attractiveness to ratings of intelligence or morality, famous under the "What is beautiful is good" label (Dion, Berscheid, & Walster, 1972).

Based on our assumptions about the EvIE, an intriguing prediction follows from the similarity property, namely that halo effects should be most apparent given positive traits and rating dimensions, but less pronounced given negative traits. This is a strong prediction insofar as there is consensus in the literature that negative information has more impact than positive information on social evaluations (e.g., Kanouse & Hanson, 1972; Peeters & Czapinski, 1990; Skowronski & Carlston, 1989).

To test this idea, Gräf and Unkelbach (2016) presented participants with targets' positive or negative traits as well as behaviours from two dimensions of social perception (Bakan, 1966; see also Abele & Wojciszke, 2018), namely communion (e.g., being honest) and agency (e.g., being industrious), and asked participants to rate the targets on other traits either from the same or the other dimension. Across three experiments, Gräf and Unkelbach investigated halo effects on 30 traits and 48 different behaviours. Participants observed a target showing either a trait label or a behavioural description and were asked how likely it was that the target would possess another trait (Experiments 1 and 2) or would show another behaviour (Experiment 3). Importantly, they varied the valence and the social perception dimension. For example, participants saw a *lying* target (i.e., a negative communion trait) and answered how likely this person was to also be *lazy* (i.e., a negative agency trait), or in another trial, how likely this person was also to be egoistic (i.e., negative communion trait). Similarly, they would see an *honest* target and answer how likely this person was to also be *industrious* (or, in another trial: *helpful*). Thus, the trials tested whether halo effects, an inference from one behaviour/trait to another behaviour/trait, vary as a function of trait/behaviour valence and as a function of within/between dimension inferences on the two fundamental dimensions of social perception.

Figure 5 shows the data from these three experiments. As predicted from the EvIE's similarity property, positive traits and behaviours lead to substantially stronger halo effects, both within and across the dimensions of communion and agency (Gräf & Unkelbach, 2016; Exp. 1 to 3; see also, 2018, for a conceptual replication). These findings are difficult to reconcile with classic assumptions about the unconditional higher impact of negative information on social evaluations, but they follow from the EvIE's similarity property. The results may also explain apparent features in the literature, namely why there are few published studies showing "negative" halo effects (i.e., "horn" effects), simply because they usually do not exist (i.e., lying does not make you lazy).

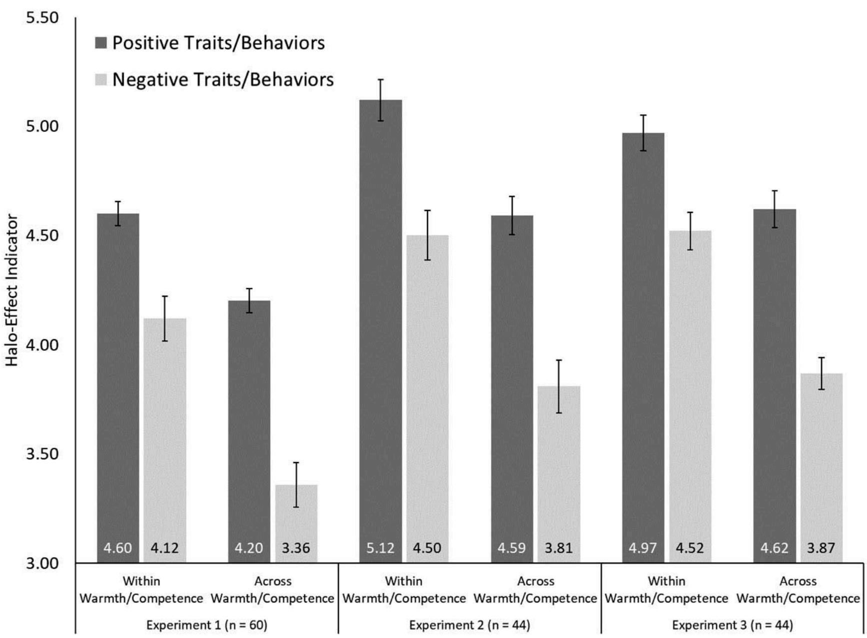

Figure 5. Results from Gräf and Unkelbach (2016; Experiment 1–3). The y-axis shows likelihood ratings for the presence of a trait/behaviour given the factual presence of a trait/behaviour (i.e., halo effect indicator) as a function of within dimension judgements (e.g., halo effects within the communion dimension: from "honest" to "helpful" or from "lying" to "egoistic") and between dimension judgements (halo effects between communion and agency: from "honest" to "industrious" or from "lying" to "lazy"). Higher values indicate stronger halo effects. The scale midpoint was 4 with a range from 1 ("not at all") to 7 ("definitely"). Error bars represent standard errors of the means.

The EvIE's frequency property also suggests an intriguing point; namely, that the observed halo effects might not be an error in ratings (Thorndike, 1920), but a true property of the ecology. Similar to our argument concerning how higher similarity follows from a higher frequency, the higher frequency of occurrence of positive traits and behaviours also implies that any positive trait or behaviour is more likely to co-occur. People should, therefore, learn that positive traits and positive behaviours appear together on a person-level. If our assumption about the EvIE's frequency property is correct, then the personality profile of being both honest and industrious is factually more likely than the profile of being dishonest and lazy. From an ecological view, the constant error in ratings observed by Thorndike might not be entirely an error after all, but a generalisation of observed ecological co-occurrence to a task involving trait ratings in a psychology experiment. Investigating this alternative source for halo effects provides a fascinating venue for future research.

Similarity and liking: your friends are all alike

The EvIE model states that positive information is more similar and less diverse compared to negative information; as Figure 4 illustrates, there is only one way (or fewer ways) to be good compared to the many ways someone might be bad. One implication of this ecological property is that liked people (i.e., someone's friends) should be more similar to one another compared to disliked people.

This is an interesting prediction, because, based on the hedonic sampling principle discussed above, people should spend more time with other people they like compared to people they do not like (Denrell, 2005). This increase in spent time should lead to more knowledge about liked people, and thereby to a more differentiated representation of these liked others. Smallman and Roese (2008) explicitly stated this as follows: "to cherish a loved one is to relish the fine nuances of his or her personality" while "the rejected and forsaken are construed on a relatively surface level" (p. 1228). However, if we assume that people like each other because they possess positive traits, attributes, or qualities which makes them likeable, the EvIE's assumed similarity property predicts that these people should be very similar, particularly in comparison to disliked people. Their mental representation might be highly differentiated as proposed by Smallman and Roese, but this differentiation does not make them dissimilar, just because the properties (i.e., traits and behaviours) that lead to liking are factually highly alike.

Alves, Koch, and Unkelbach (2016) conducted seven experiments to test whether people see other people they like as more similar to one another compared to people they dislike. We discuss five of these experiments in the following. The basic paradigm was straightforward. Participants generated names of target persons they liked and of targets they disliked. Then, they used the spatial arrangement method described above (see Figure 1's right panel; Hout et al., 2013) or pairwise similarity ratings (see Figure 1's left panel) to arrange these targets on the screen according to the similarities of their personalities. They also provided ratings of the time spent together with these people and of how much they knew about them. As expected, participants reported having spent more time with liked compared to disliked targets, and they reported knowing more about the liked compared to the disliked targets. Yet, in line with the prediction from the EvIE, participants consistently reported higher similarity for liked and disliked targets.

Figure 6 provides a summary of the similarity judgements from Experiments 1, 3 and 5. Experiment 1 used target persons participants knew personally with spatial arrangement to assess similarity. Experiment 3 used target persons participants knew personally with pairwise comparisons to assess similarity. Experiment 5 used celebrity targets with pairwise comparisons. As Figure 6 shows, participants consistently reported liked targets to be more similar than disliked targets, despite spending more time with them. We omit Experiments 2 and 6 here; Experiment 2 replicated Experiment 1 with target valence manipulated between participants and Experiment 6 replicated Experiment 5 with a larger set of celebrity targets.

Experiment 4 tested the underlying EvIE structure directly. Participants generated as many traits as they could for each of the four liked and disliked targets they named. First, in line with the assumed greater knowledge for liked targets, participants generated on average 6.9 traits for liked, but only 3.9 traits

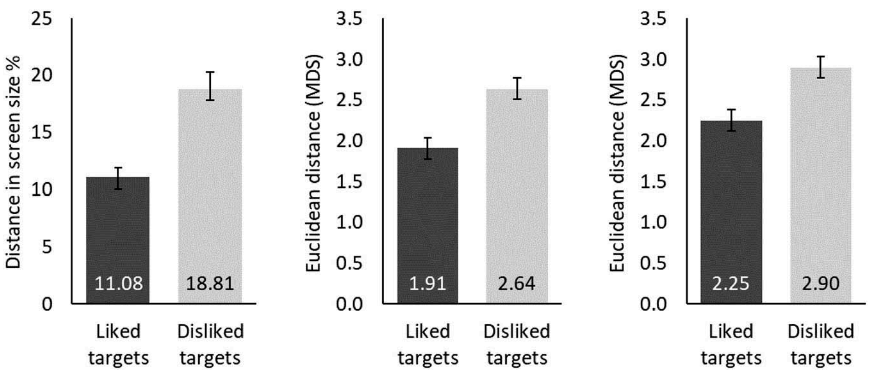

Figure 6. Similarity assessments from Experiments 1 ($n = 71$), 3 ($n = 70$), and 5 ($n = 71$) in Alves et al. (2016), from left to right. The left panel shows personally known targets with spatial arrangements. The middle and right panels show Euclidean distances based on pairwise comparisons. The middle panel shows distances for personally known targets and the right panel for celebrity targets. Higher values indicate greater distances between targets (and thereby, lower similarity). Error bars show standard errors of the means.

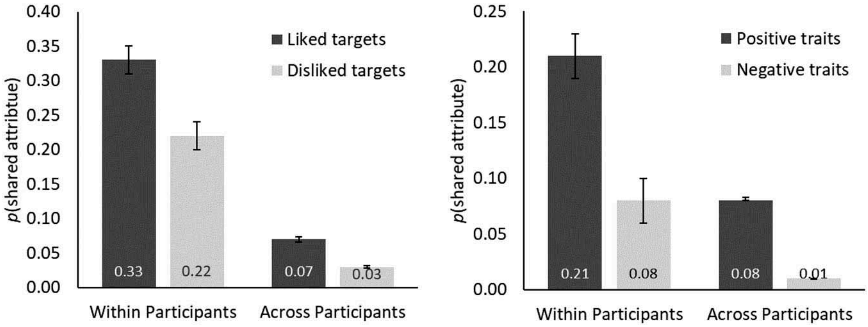

Figure 7. Probability that a given generated trait will be shared among two or more targets for liked and disliked target persons (Exp. 4 in Alves et al., 2016; $n = 70$) and for positive and negative traits (Exp. 7, Alves et al., 2016; $n = 101$). Within each panel, the left part shows the mean probability within each participant, the right part shows the mean probability across participants; this is, how likely does a given trait occur for any other target across participants. Error bars represent standard errors of the means.

for disliked targets. Second, we computed the probability that a trait was shared among the targets. Figure 7‘s left panel shows the relevant data. The probability that participants generated *shared* traits among liked targets was substantially higher compared to disliked targets. This was true within participants' eight targets, but also across participants; that is, even across participants, liked targets were more likely to share traits and therefore be more similar, providing support for the assumption that there are ecologically fewer ways to be liked than to be disliked. This difference in shared traits also held when controlling for the number of generated traits in a regression analysis.

Experiment 7 then flipped the paradigm and asked participants to generate the names of two people they personally knew without specifying whether they had to be liked or disliked. Instead, we asked them to generate either positive traits or negative traits that described each of the two targets. After providing as many traits as they could, we asked participants to rate the similarity of the two targets. First, as expected, participants showed the reversed effect as well – generating positive traits made the two targets appear more similar compared to generating negative traits. As the targets were selected in both conditions before we asked for positive or negative traits, any alternative explanation in terms of differential target generation is taken care of. In addition, participants generated more traits in the positive traits condition, 6.4 on average, compared to the negative traits condition, where they generated only 3.8 traits on average. Replicating Experiment 4, as shown in Figure 7‘s right panel, the probability that participants generated *shared* traits among positive traits was substantially higher compared to negative traits. This was again true within and also across participants, and also when controlling for the absolute number of traits generated.

Across seven experiments, of which we summarised five here, we found that positive traits are more frequently generated and these generated traits also are more likely to be found across targets, leading to the conclusion that liked people tend to be seen as alike. In particular, the within-participant comparisons might partially follow from intra-psychic mechanisms (e.g., motivated reasoning to see your friends as similar and good); however, the effects across-participants are difficult to explain without the presented EvIE model (see Figure 7).

Frequency and valence: the common good in person perception

In another series of experiments (Alves, Koch, & Unkelbach, 2017b), we tested a prediction from the frequency property discussed above: If positive information is more frequent, then it should more likely co-occur with other positive information compared to negative information. Across people, this implies that people have positive traits in common, but their negative traits make them distinct: "Those attributes that connect different people and that define their similarities are usually good attributes. Those attributes that distinguish different people and make them unique are often bad attributes." (p. 512). This prediction follows solely from the frequency property and does not depend on the similarity of the information.

For illustration, let us again consider the formal relation of shared and unshared positive and negative attributes, as we did above for personality traits. For example, positive attributes may have the probability of being present in any person of $p(\text{pos}) = 0.6$, and negative attributes may have a probability of being present of $p(\text{neg}) = 0.2$. The probability of a *shared* attribute (i.e., being simultaneously present in two persons) being positive is then $p(\text{positive}|\text{shared}) = p(\text{pos})^* p(\text{pos}) = 0.36$, while the probability for the negative attribute is $p(\text{negative}|\text{shared}) = p(\text{neg})^* p(\text{neg}) = 0.04$. In other words, if a positive trait is three times more likely in the ecology than a negative trait, it is nine times more likely to be shared than a negative trait. This leads to two hypotheses: positive traits should be more likely to be shared amongst targets compared to negative traits, $p(\text{shared}|\text{positive}) > p(\text{shared}|\text{negative})$, and shared traits should be more likely to be positive compared to negative traits, $p(\text{positive}|\text{shared}) > p(\text{negative}|\text{shared})$.

To test these hypotheses, Alves et al. (2017b) asked participants to sample traits of target persons. Experiments 1a and 1b tested the first prediction, $p(\text{shared}|\text{positive}) > p(\text{shared}|\text{negative})$. In Experiment 1a ($n = 41$), participants generated two people they knew personally and then generated four positive traits and four negative traits for one of the two. Then, we asked them which of the eight traits also described the other person. In line with our first prediction, participants assigned on average 3.4 positive traits (i.e., almost all) two both targets. Out of the four negative

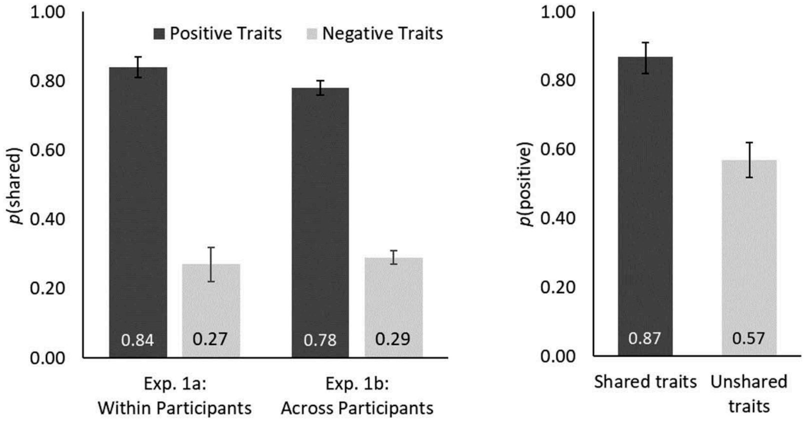

Figure 8. Trait probabilities from Alves et al. (2017b)'s Experiments 1a and 1b (left panel) and Experiment 2 (right panel). The left panel shows the probability that a trait is shared given that it is positive or negative within and across participants. The right panel shows the reverse probability that a trait is positive given that it is shared or unshared. Error bars represent standard errors of the means.

traits, they assigned only 1.1 to both targets. Figure 8's left panel reports the respective conditional probabilities for positive and negative traits.

To generalise this result, Experiment 1b (n = 82) asked participants to generate 10 target persons. Then, we *randomly* sampled a given set of four positive and four negative traits from Experiment 1a and participants had to indicate to which of the 10 targets each of the traits applied. Replicating 1a, participants assigned on average 3.1 of the positive traits to a target from their own sample, but only 1.2 of the negative traits. Figure 8 shows the resulting conditional probabilities. As the left panel shows, positive traits were much more likely to be shared across participants compared to negative traits. And as the trait and target generation were separated in Experiment 1b, this replication provides support for our ecological argument.

Experiment 2 in this series of "common good" experiments (Alves et al., 2017b) tested the second prediction: if a trait is shared as opposed to unshared, it should be more likely positive, and thus, $p(\text{positive}|\text{shared}) > p(\text{negative}|\text{shared})$. Participants again generated two target names; then, we asked them for either shared or unshared traits. We asked for four shared traits in the former, and two traits that belonged uniquely to the first target, and two traits that belonged uniquely to the second target, in the latter condition. Then, participants rated the valence of the generated traits. Figure 8's right panel shows the probabilities: Overall, participants generated more positive traits than negative traits in both conditions, reflecting the general positivity prevalence. Yet, in the shared condition, 3.5 traits were positive on average, and only 0.2 traits were negative. In the unshared condition, 2.3 traits were positive and 1.3 traits were negative. Thus, the traits people have in common are usually positive.

Experiment 4a (n = 176) in Alves et al. (2017b) aimed to show that searching for similarities (i.e., shared traits) amplifies the ecological default, and searching for differences (i.e., unique traits) attenuates it. Thus, the experiment replicated Experiment 2 but included a "natural" condition, in addition to the "shared" and "unshared" conditions. The "natural" condition asked participants to generate traits for two target persons without specifying whether these should be shared or unshared traits. Again, across conditions, participants generated substantially more positive traits: about 4.8 traits out of six were positive. However, the probability of generating a positive trait varied as a function of the traits being generated as "shared", "unshared", or "natural" (i.e., without specific instructions). Figure 9 shows these probabilities of a trait being positive. The probability of a trait being positive was smaller in the natural condition compared to the "shared" condition, and smaller in the "unshared" condition compared to the "natural" condition. Thus, as predicted, looking for similarities amplifies the prevalence of positive traits, while looking for differences attenuates it.

A basic drawback in the reported "common good" studies so far is that participants self-generated targets, which makes the observed "common good" effect less surprising, as most people might generate people they know and also like, and the phenomenon might follow from the "my friends are all alike" effect described above. However, the present approach is different as it is solely

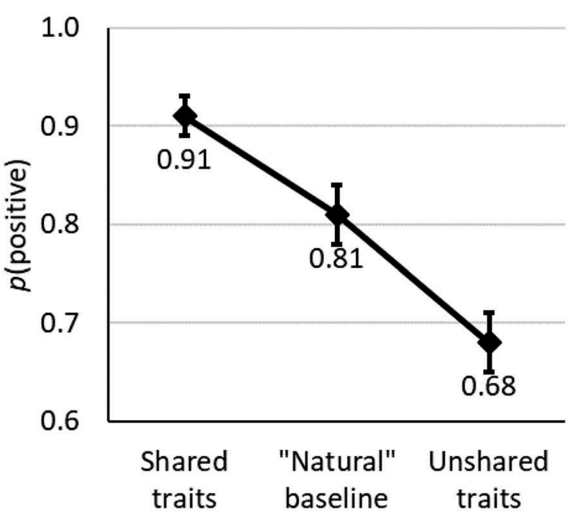

Figure 9. The probability of a trait being positive as a function of participants generating traits as shared traits, unshared traits, or generating traits without instructions (i.e., natural baseline condition). Error bars represent standard errors of the means.

based on the proposed EvIE's *frequency* property. The similarity property implies that positive information should always be more similar to other positive information (again; there is only one way to be good), and thus, as long as people have friends they like, these should be *alike*.

The present "common good" effect, however, follows only if the available information is predominantly positive. This leads to the reverse prediction if the available information is predominantly negative. Thus, in Experiments 5 and 6 in Alves et al. (2017b) "common good" series, participants did not generate targets, but we provided liked and disliked targets for which the available trait information should be either predominantly positive or negative, respectively. To do so, Experiment 5 took advantage of the US's bipartisan political structure of Democrats and Republicans and recruited 310 US participants online. Half of the participants generated either shared or unshared traits for Mitt Romney and George W. Bush, two well-known republicans, and the other half did the same for Bill Clinton and Barack Obama, two well-known democrats. To divide the sample, we asked participants how much they liked these political figures; 160 participants reported liking the politicians in their respective conditions, and 143 participants reported disliking them. Seven participants reported neither liking nor disliking them and were excluded from the analysis.

In Experiment 6 (n = 307), we sampled the target persons from a list of the 10 most popular and most unpopular people other participants generated. The 10 most popular people for US citizens were Abraham Lincoln, John F. Kennedy, Elvis Presley, Martin Luther King, Oprah Winfrey, Taylor Swift, George Washington, Michael Jordan, Beyoncé Knowles, and Jesus Christ. The 10 most unpopular people were Adolf Hitler, Donald Trump, George W. Bush, Osama Bin Laden, Saddam Hussein, Joseph Stalin, Kim Jong Un, Justin Bieber, Fidel Castro, and Kanye West. For example, participants generated four traits that Abraham Lincoln and Elvis Presley shared or two traits that were unique to Lincoln and Presley, respectively. Each pairing was randomly created for each participant. In the negative targets condition, for example, participants generated traits that Adolf Hitler and Justin Biber shared, or two traits that were unique to each of these targets.

Figure 10 shows the results for these two studies, plotting the frequency of traits being positive and negative as a function of being shared or unshared among the target persons. For liked targets, the trait frequencies replicate the previous studies. Both for liked political figures of that time as well as consensually liked persons, looking for similarities yielded many positive traits, and few negative traits. Looking for differences yielded fewer positive traits and more negative traits. However, when participants disliked the targets, that is, when operating in an ecology of predominantly negative information, they generated more negative traits in the shared compared to the unshared condition. Conversely, they provided fewer positive traits in the

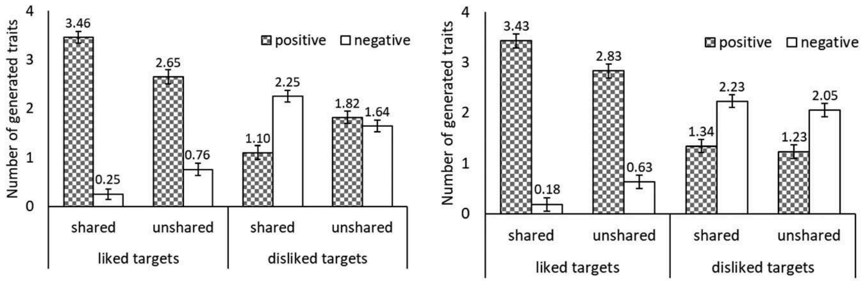

Figure 10. Mean number of generated positive and negative traits for liked and disliked targets as a function of shared and unshared traits. The left panel shows the results for liked and disliked politicians and liked and disliked celebrities (Exp. 5 and 6 in Alves et al., 2017b, respectively). The common good phenomenon is present only for liked targets and fully (Exp. 5) or partially (Exp. 6) reverses for disliked targets. Error bars represent standard errors of the means.

shared compared to the unshared condition. This pattern of results provided distinct evidence for the "common good" implication of the EvIE's assumed frequency property. Looking for similarities between targets amplifies, and looking for differences between targets attenuates, the underlying base-rate; and this base-rate is, in most cases, marked by a high frequency of positive information, leading to a "Common Good" phenomenon.

Thus, based on the assumption that positive information is more frequent, we predicted and found a novel phenomenon in person perception – the common good effect. The attributes people have in common are usually good attributes, and negative attributes are rather unique. In addition, searching for similarities leads to the discovery of the common good, while searching for differences subjectively attenuates the prevalence of positive information.

Intergroup biases: a cognitive-ecological explanation

Having shown implications of positive information's higher similarity (strong halo effects from positive traits; friends are more alike than enemies) and positive information's higher frequency (the common good phenomenon), our final example provides a genuinely new explanation for intergroup biases (Alves, Koch, & Unkelbach, 2018), by combining basic cognitive processes with our assumptions about the EvIE.

One of the most prominent effects in social psychology is that people tend to devalue minorities (e.g., refugees, immigrants) and out-groups (e.g., rival sport teams, other states). There is a wealth of models and theories to explain these biases (e.g., Tajfel and Turner's Social Identity Theory, 1979; or Brewer's theory of optimal distinctiveness, 1991). However, taking the assumed EvIE properties offers a novel explanation.

For this explanation, we only need the assumption that out-groups and minorities are "novel" groups in comparison to ingroups and majorities. This is highly plausible, as people usually come in contact first with their ingroups (e.g., family, fellow citizens) and majorities (e.g., Whites, Christians); they learn about outgroups and minorities later and these groups are then novel in comparison to the former.

On the cognitive side, novel groups are defined in relation to existing groups (i.e., ingroups, majorities) by the attributes that make them unique, rather than by the attributes they have in common with existing groups (Hodges, 2005; Sherman et al., 2009; Tversky & Gati, 1978). On the ecological side, as the presented evidence suggests, positive attributes are less diverse or more similar than negative information, and positive information is more frequent than negative information. Consequently, unique attributes that differentiate a novel group from already-known groups are likely to be negative.

Thus, the argument is as follows: Minorities and outgroups are most likely novel groups to social perceivers, compared to majorities and ingroups. Novel groups are defined by their unique attributes (i.e., the cognitive part) and unique attributes are most likely negative (i.e., the ecological part), leading to an association between outgroups and minorities with negative attributes, which in turn may cause negative stereotypes and prejudice.

To test this explanation, we invited participants to take the role of space explorers. On a novel planet, they would encounter members of two alien tribes. We used the neutral aliens provided by Gupta et al. (2004) as stimuli. Participants would encounter one member of the first tribe and receive information about one of the alien's trait; that is, they saw a picture of the alien and the alien's respective trait (e.g., helpful, intelligent, anxious, or aggressive). After participants had encountered six members of the alien tribe, we instructed participants to imagine that they would now continue their travels and encounter another alien tribe. Then, they would learn about the traits of six members of the second tribe. In the real world, people should probabilistically learn first about members of their ingroup before learning about members of outgroups. Similarly, they are more likely to meet majority group members before meeting minority group members. Thus, the first tribe is functionally similar to a majority or ingroup, and the second tribe is functionally similar to minorities or out-groups. After these learning phases, participants chose which group they preferred.

The central manipulation across three experiments was the trait pool from which we assigned the two tribes' traits. After learning, we asked participants which tribe they prefer; that is, we elicited a binary preference choice between the first and the second tribe as the central dependent variable. Experiment 1 manipulated whether the positive or whether the negative

Table 4. Preferences for space alien tribes in Experiments 1–3 (data from Alves et al., 2018) as a function of standard and reversed ecologies.

	Experiment 1: Direct manipulation		Experiment 2: Diversity		Experiment 3: Frequency	
	1st Tribe	2nd Tribe	1st Tribe	2nd Tribe	1st Tribe	2nd Tribe
Standard ecology: positive shared and negative unique	68	36	78	29	64	33
Reversed ecology: negative shared and positive unique	44	62	50	53	51	56
Chi-square test	$X^2(1, N = 210) = 12.02$, $p < .001$		$X^2(1, N = 210) = 13.08$, $p < .001$		$X^2(1, N = 204) = 6.94$, $p = .008$	

Experiment 1 manipulated the ecology directly, while Experiments 2 and 3 randomly created the ecologies by manipulating the diversity (Experiment 2) and the frequency (Experiment 3) of positive and negative information. The reported chi-square tests the interaction of the ecology and the preference for the first tribe.

attributes were shared or unshared among the two groups. That is, in one condition, the groups' positive attributes were identical, while their negative attributes differed, and this was reversed in the other condition. Table 4's left section presents the resulting preference frequencies. As predicted from our cognitive-ecological explanation, participants preferred the first group when the positive attributes were shared and negative attributes were unique, but preferred the second group when positive attributes were unique and negative attributes were shared. In other words, although the distribution of positive and negative traits was identical, there was a bias against the novel group in a standard ecology (i.e., where negative information is unique), which reversed as a function of the trait ecology.

Experiment 2 then manipulated the similarity of evaluative information in the ecology. We created two attribute ecologies. In the standard ecology, positive attributes were less diverse compared to negative attributes. In the reversed ecology, negative attributes were less diverse. We manipulated diversity by the number of unique traits in a given ecology. In the standard ecology condition, we randomly sampled each alien tribe's three positive traits from a set of four traits, while we sampled the three negative traits from a set of 16 traits (i.e., there were more ways to be negative). In the reversed ecology condition, we sampled the alien tribes' three negative traits from a set of four traits, and their positive traits from a set of 16 traits (i.e., there were more ways to be positive). Consequently, in the standard ecology, the positive traits were likely to be shared and the first tribe should be preferred. In the reversed ecology, the negative traits were likely to be shared and the second tribe should be preferred. As Table 4's middle panel shows, the preference frequencies replicated Experiment 1. Participants preferred the first group in the standard ecology (i.e., when negative attributes were likely unique), but in the reversed ecology they preferred the second group (i.e., when positive attributes were likely unique).

Experiment 3 then manipulated the EvIE's second property, the frequency of evaluative information. In the standard ecology, both groups possessed more positive than negative attributes, while in the reversed ecology, negative attributes were more frequent. Specifically, in the standard ecology, both tribes displayed four positive traits and one negative trait. Both positive and negative traits were randomly sampled from a set of six positive and six negative traits. In the reversed ecology, both tribes displayed four positive and one negative trait. Consequently, in the standard ecology (positive frequent), unique attributes were likely to be negative, while in the reversed ecology, unique attributes were likely to be negative.

Table 4's right section shows the respective preference frequencies. Replicating Experiments 1 and 2, participants preferred the first group in the standard ecology, but they preferred the second group in the reversed ecology. One apparent feature of Table 4 is that the standard ecologies (i.e., when negative information is unique) yield stronger differences between the tribes, while the preference differential is less strong when positive information is unique. This is actually in line with our overall assumptions about the EvIE. We did not control for the connotative similarity of the positive and negative traits, but research on the similarity of personality traits (Bruckmüller & Abele, 2013; Gräf & Unkelbach, 2016; Leising et al., 2012) shows that positive traits are more similar to each other compared to negative traits. By implication, the positive unique traits were, less "unique" compared to the negative unique traits. This differential valence asymmetry explains at least part of the differential impact of the ordering.

Thus, across three experiments, participants associated a novel group with its unique attributes, which differentiate the group from previously encountered groups. Depending on the ecology's properties, unique attributes were more likely to be positive or negative, and participants' preferences followed accordingly. As the general structural properties of the EvIE make unique attributes more likely negative, $p(\text{negative}|\text{unique}) > p(\text{positive}|\text{unique})$, an evaluative disadvantage for novel groups, and thereby for minorities and outgroups, follows. In other words, people do not need a real conflict (Sherif, Harvey, White, Hood, & Sherif, 1961), motivated reasoning (Kunda, 1990), or a hostile personality structure to show differential preferences for minorities and outgroups (Altemeyer, 1998). Rather, all they need is a cognitive system that tries to differentiate different groups in an ecology that is marked by high similarity and a high frequency of positive information.

Summary of the implications

We have provided two examples of how our EvIE model refines our knowledge about classic and important social psychological phenomena. First, halo effects; we have delineated and shown that halo effects appear predominantly for positive traits, but are largely absent for negative traits, despite the typically assumed stronger impact of negative information (Baumeister et al., 2001; Ito, Larsen, Smith, & Cacioppo, 1998). Second, intergroup biases; we have provided a cognitive-ecological explanation for intergroup biases that do not rely on motivated reasoning (Kunda, 1990; Tajfel & Turner, 1979), but builds solely on cognitive processes that interact with the EvIE's properties.

We have also provided two examples that illustrate the discovery of genuinely new phenomena. First, people's friends are all alike. Based on the proposed similarity property, we have shown that people perceive others they know and like as more similar to one another, just because there is not much room for variety on the positive side. Second, the common good phenomenon; based on the proposed frequency property, we have shown that what people have in common are usually positive attributes, just because negative attributes are infrequent, and their joint occurrence is therefore unlikely.

Relation to other models

We suggested in the introduction that within social psychology, theories and models of the social environment are scarce. This is true on a quantitative level; there are relatively few papers that address the ecology per se in comparison to the many papers that address the person or the person within an experimental environment. Nevertheless, there are highly influential empirical demonstrations and models from which we borrowed and on which we built.

Amongst the milestones of empirical research are Hamilton and Gifford (1976) idea of illusory correlations, in which they already showed that a minority group is evaluated more negatively if positive behaviours are frequent in the respective ecology. This study is one of the grandfathers of cognition–ecology interactions, as Hamilton and Gifford also showed that by changing the ecology, making negative behaviours frequent, the minority evaluation changes and participants evaluate the minority more positively. Another famous instance of cognition–ecology interactions is Lichtenstein, Slovic, Fischhoff, Layman, and Combs (1978) empirical demonstration that the ecological presence of causes of death in newspapers is a predictor of people's subjective probability of causes of death (Combs & Slovic, 1979). For example, newspapers report substantially more deaths from accidents or disasters compared to the frequency of deaths from diseases, and people's estimates are influenced by these reported causes of death. Finally, there is a long tradition of experimental demonstrations from judgement and decision-making, showing that people learn ecological cues (e.g., large cities have airports) and use these cues to make judgements. This research contextualises judgements strategies as learned adaptations to ecological structures. For example, if asked whether City A or B is larger, and only one city has an airport, typically the city with the airport is chosen (see Gigerenzer & Todd, 1999, for a summary).

Beyond empirical demonstrations, there are also important models and theories on which we built. Most notably, Lewin's (1939, 1951) field theory provides the basis for many of the points we addressed in this review. In particular, Lewin assumed that people are not motivated by forces within the organism, but by the tension resulting from the organisms' needs and goals and the affordance within the "fields" of the life space in which the organism operates, summarised in the, in hindsight obvious, insight that behaviour is a function of the person and the environment, B = *f*(P, E). Most importantly for our present approach, Lewin provided the definition of a field's valence as the interaction of the person and the attributes of the "field".

The present approach is also in line with Brunswik (1955), who emphasised that psychology should be a science of organism–environment relations, and we obviously share his emphasis. However, Brunswik also assumed that the environment is "semierratic" (p. 193), which led to his idea that psychological research needs a "representative design", in which the variables of interest are sampled from the respective ecology. As the review of our own theoretical and empirical work shows, we make rather strong assumptions about the systematic rather than the erratic nature of the ecology, and as the factorial nature of our experiments shows, we are rather far removed from Brunswik's vision on the empirical level.

A more recent model on which we build is the cognitive-ecological sampling approach by Fiedler (2000; see also Fiedler & Juslin, 2006). The sampling approach assumes that most biases in judgement and decision-making do not emerge at the stage of information integration, but at the stage of information sampling. Applied to the question of the differential impact of negative information on impressions, the sampling approach would assume that organisms oversample negative information, but do not weigh it differentially when forming a judgement. A strong prediction of the sampling approach is that if information is sampled representatively, many apparent judgement biases and fallacies disappear.

With these models and theoretical positions in mind, it becomes apparent what the EvIE adds. Within Lewin's (1951) field theory, the EvIE proposes that more fields within an organism's life space have positive valence as a function of the properties of the field and the needs and goals of the organism. In addition, these fields should be more similar to each other compared to fields of negative valences. Within Brunswik's (1955) perspective of psychology as a science of organism–environment relations, the EvIE adds that the ecology is not erratic, but when it comes to evaluations, the ecology is rather systematic, allowing predictions based on the assumed properties of frequency and diversity. And within a sampling approach, the EvIE predicts that an unbiased sample of evaluative information should deliver a skewed frequency rate and a similarity asymmetry between positive and negative information. We thus believe the EvIE model presents progress towards a better understanding of the social environment and allows predictions that cannot be delineated from existing models alone.

Benefits and drawbacks of an ecological approach

The present EvIE model is, as the name suggests, an ecological model. Ecological models consider the mind within the context of its ecological structure. This approach has advantages. First, it acknowledges that sometimes the orthogonal approach in many social psychological experiments may hide rather than reveal the underlying causal variables. For example, let us assume one would manipulate valence in a typical experiment of impression formation. A standard paradigm would keep the frequency of a target's positive and negative behaviours constant. That is, participants will observe good and bad deeds with the same frequency. One might observe that bad deeds influence impressions more than good deeds. However, this might follow just because people have learned ecologically that bad deeds are rare and unique; therefore, if they appear in a 50:50 fashion, participants assign accordingly more weight to them (Skowronski & Carlston, 1987). A negativity bias in impression formation then follows because participants apply what they have learnt ecologically to what is presented experimentally.

The usefulness of considering the ecological structures is also evident in many paradigms that do not involve evaluative processes *per se*. For example, people seem to overstate their confidence in their own knowledge (Lichtenstein & Fischhoff, 1977); and people seem to be poorly calibrated with regard to their knowledge about what they factually know (see also Dunning, 2011). However, Juslin (1994) showed that if one selects the questions randomly from the ecology, the overconfidence phenomenon disappears, and depending on the specific question selection, one may create underconfidence, the same way we have created a preference for novel groups when the ecology is marked by a high frequency of negative information. Similarly, Walasek and Stewart (2015) showed that the robust findings of loss aversion (i.e., losses "loom larger" than gains) may depend on the differences in the distribution of gains and losses people experience in their ecology; they argued that losses loom larger because people ecologically experience monetary losses in small units (i.e., people always make payments in small chunks), but gains appear mostly in large units (i.e., people get their whole salary in one big unit at the end of the month). They manipulated the range of participants' gains and losses and, depending on that range, they could observe typical loss aversion, but also loss neutrality, and even the reverse of loss aversion.

Second, ecological approaches also provide more "distance" between explanations for to-be-explained phenomena. In 1913, Watson stated that psychology should concern itself only with observable behaviours, and thus, explanations for behaviour should rest within observable data (Watson, 1913). Over a hundred years later, social psychology uses a wide array of *a priori* unobservable constructs that are made accessible via more or less complex measurements. The most prominent construct is probably the attitude construct and the use of such constructs proved to be a highly successful approach to understand the complexity of human behaviours (Bohner & Dickel, 2011). However, it leads to the problem that observed behaviour or results that are indicative of a construct are also explained with other intrapsychic constructs; for example, when an attitude score is used to explain a rating about a group. This point has been raised by Fiedler (2014, p. 659), who claimed that, "The intrapsychic concepts that have dominated social psychology for decades are [...] too proximal and overlapping with the behaviors they are to explain." This is a strong advantage of ecological approaches. The explanation is farther removed from the phenomenon and this "explanatory distance" avoids the problem of overlap between the two.

Third and finally, an ecological approach leads to explanations that cannot be derived from purely psychological approaches. For example, the internal experience of processing fluency or subjective ease has been claimed as a determinant of subjective truth (Reber & Schwarz, 1999; Unkelbach & Rom, 2017): People believe information that is easily or fluently processed. Note that while this explanation seems intuitively appealing, an intrapsychic experience ("fluency") is used to explain another intrapsychic experience ("subjective truth"), which is then expressed in observable judgements. However, the explanation becomes a stronger theoretical approach when one considers that processing fluency may correlate with the factual status of the world (see Herzog & Hertwig, 2013; Unkelbach & Greifeneder, 2013), and consider the potential distribution of truth and falsity in the environment (Reber & Unkelbach, 2010). Similar to Juslin (1994) or Walasek and Stewart (2015), one may then manipulate this ecological correlation in experimental settings and observe the reversed effects of processing fluency on judgements (e.g., Olds & Westerman, 2012; Unkelbach, 2006, 2007; Unkelbach, Koch, Silva, & Garcia-Marques, 2019).

Despite these advantages of an ecological approach, there are drawbacks. First and foremost, ecological explanations are in their truest meaning not accessible to direct experimental tests or even correlational tests. The ecological properties must remain on the level of distal hypothetical constructs. One may collect proximal evidence for the properties that is consistent or inconsistent with the assumed properties, as we tried to do in the beginning within our evidence section. Final causal proof, however, remains outside the domain of empirical research. As discussed in the respective section, the same is true for most psychological constructs; even the most prominent ones, such as “memory” or “attitude”, are ultimately not accessible to direct empirical tests. Yet, for ecological approaches, this is more apparent.

The empirical proxy solution of creating new ecologies within an experimental setting, as implemented in some of the reported experiments, must thus remain on the proof-of-concept level. One cannot randomly assign people to different ecologies in the real world. However, we strongly believe that a good theoretical approach may operate under assumptions about the ecology and then make predictions about behaviour. That is, we may *assume* that people’s evaluative information ecology is marked by positive information’s higher frequency and similarity. However, when we observe the predicted effects experimentally, this provides indirect support for the assumption that positive information is more similar and occurs more frequently than negative information.

To be sure, this does not imply denying the existence of intra-psychic constructs as in Watson’s (1913) radical behaviouristic way. Rather, we strongly believe that exactly the combination of well-established intra-psychic principles with assumed properties of the evaluative ecology leads to the discovery of novel phenomena and stronger and more complete theories within social psychological research.

Conclusions

Social psychology is interested in the interaction of the individual with the environment. As suggested by Lewin, one needs to address this to understand feelings, thinking, and behaviour (Lewin, 1939; 1943). Here, we have focused on the environmental side, and proposed a model that specifies structural properties “good” information and “bad” information in people’s environment. In particular, we suggested that people’s evaluative information ecology, the EvIE, is marked by the higher frequency of positive information and by the lower diversity/higher similarity of positive information to other information of the same valence, compared to negative information. We defined the ecology in line with Brunswik (1955) as the “objective, external potential offered to the organism” and information within this ecology as anything the organism might evaluate as “good” or “bad” based on its needs and goals.

We provided *evidence* for the EvIE’s properties of differential frequency and differential similarity/diversity from multiple sources. Psycho-lexical studies show that words describing positive states of the world are more frequent in language compared to negative words (i.e., differential frequency), while there are more words to describe negative states (i.e., differential diversity). Research on emotions shows that most people feel good most of the time (i.e., differential frequency), but there are more ways to feel bad (i.e., differential diversity). Finally, we reported studies that assessed similarity of positive and negative information directly, and from small-scale experimental test up to large-scale databases of pictures and words, positive information is more alike than negative information.

We provided suggestive *explanations* for these properties. Higher frequency should follow from the adaptive nature of positive behaviours in social situations, the cultural reinforcement of positive behaviours, and the hedonic sampling of positive information. Higher similarity follows psychologically from positive information's higher frequency; information that occurs more frequently will co-occur more frequently, leading to higher subjective similarity. Higher similarity also follows from the range principle, which states that a "good" range of a variable is typically framed by two negative ranges (e.g., a comfortable temperature is framed by "too hot" and "too cold").

Finally, we provided *implications* and respective empirical tests that illustrate the usefulness of our ecological approach. The ecological approach predicts, and we showed, that halo effects in impression formation are present for positive information, but not for negative information (i.e., lying does not make you lazy), that likeable people are more similar to each other compared to how similar unlikeable people are to each other (i.e., your friends are all alike), that looking for similarities makes target persons more positive than looking for differences (i.e., there is a "common good"), and that preferences from groups may follow from the ecological properties without assuming motivations or biases (i.e., a cognitive-ecological explanation of intergroup biases).

Based on this triad of evidence, explanations, and implications, we believe the conclusion is justified that good is indeed ecologically more alike and more frequent than bad. Taking this ecological perspective into account will refine existing models and lead to the discovery of novel regularities within human behaviour.

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