Opinion

Why Good Is More Alike Than Bad: Processing Implications

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Humans process positive information and negative information differently. These valence asymmetries in processing are often summarized under the observation that 'bad is stronger than good', meaning that negative information has stronger psychological impact (e.g., in feedback, learning, or social interactions). This stronger impact is usually attributed to people's affective or motivational reactions to evaluative information. We present an alternative interpretation of valence asymmetries based on the observation that positive information is more similar than negative information. We explain this higher similarity based on the non-extremity of positive attributes, discuss how it accounts for observable valence asymmetries in cognitive processing, and show how it predicts hitherto undiscovered phenomena.

Trends

Valence asymmetries describe differences in how humans process positive and negative information. They are evident at all stages of information processing and have been summarized under the observation that 'bad is stronger than good'.

Many researchers have argued that valence asymmetries result from internal affective reactions. Because negative information is more relevant for well-being, it elicits a strong affective reaction, which triggers deeper and more elaborate processing.

We provide an alternative explanation for valence asymmetries in cognitive processing based on the observation that positive information is more similar than negative information. We argue that this similarity difference is inherent in the information environment. It results from the well-established assumption that positive states are non-extreme. Most attribute dimensions host one (non-extreme) positive range framed by two (extreme) negative ranges. Consequently, positive persons, objects, or words are more similar to one another than negative ones.

Positive information's higher similarity provides a viable alternative explanation for valence asymmetries because interstimulus similarity influences all stages of cognitive processing.

Processing Positive and Negative Information

The evaluation of information as good or bad is one of the most central aspects of human functioning [1,2]. Psychologists have long recognized that valence is probably the most basic psychological dimension on which people can easily locate any stimulus. Positive and negative, good and bad, can be interpreted as two symmetrical poles of this evaluative dimension, like hot and cold, or black and white. Therefore, one may argue that positive and negative information should constitute two equal and symmetrical classes. However, this symmetry seems not to hold. There are robust asymmetries in the processing of positive and negative information at virtually all levels of human information processing (but see [3]). Negative information draws more attention [4], leads to stronger neurological reactions [5], and is recognized more accurately [6]. Most of these asymmetries can be summarized under the observation that 'bad is stronger than good', meaning that negative information has a stronger psychological impact than positive information [7].

Negative information's stronger impact is commonly attributed to affective and motivational reactions within the information-processing individual. Because negative information is more relevant for well-being, it elicits stronger affective and motivational reactions, which then trigger 'deeper and more elaborate' processing [8]. There is ample evidence for the greater affective and motivational potential of negative information and for the notion that affective and motivational states influence information processing (Box 1). Hence, asymmetries in the processing of positive and negative information seem to constitute phenomena that emerge inside the information-processing individual.

In contrast, we propose that some valence asymmetries might not be caused by internal affective or motivational forces but may originate in the structure of the information itself. Specifically, positive and negative information generally differ regarding a crucial property, namely, similarity. Positive information is more similar to other positive information, compared to negative information's similarity to other negative information. This differential similarity is a general, robust, and objective property of the information environment and is independent of

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Box 1. How Affect and Motivation Shape Information Processing

Many explanations for observable differences in the processing of positive information and negative information refer to affective and motivational reactions within individuals that are elicited when they are confronted with positive stimuli or negative stimuli. It is assumed that negative stimuli like aversive pictures or words elicit a stronger affective and motivational reaction than positive stimuli [7,54,85]. The strong negative affect in turn gives rise to more effortful, systematic, analytic, and vigilant information processing [8,86–89]. Positive affect, by contrast, is argued to trigger more heuristic, superficial, and rapid processing [90].

This differential processing is evolutionarily adaptive, because negative information (e.g., a predator) is more relevant for immediate survival than the potential long-term benefits of positive information (e.g., a food source). Negative stimuli are thereby more potent, meaning that they are more threatening to the organism than positive events are beneficial. The consequences of negative events are often irreversible. In its most extreme form, negative events can lead to the organism's death. Because avoiding risks of death should have the highest priority in the evolutionary scheme, human information processing should be shaped accordingly. Further, negative events are more contagious, meaning that their effects easily turn positive entities bad, while the reversed effect is much weaker [91,92]. For example, a drop of oil can spoil a barrel of drinking water, while a drop of water does not turn a barrel of oil drinkable.

Strong evidence for this evolutionary interpretation of valence asymmetries comes from behavioral and physiological studies in humans and animals. Studies of animal learning show that negative reinforcement is more effective in producing acquisition of a behavioral reaction (e.g., escape) than positive reinforcement. Avoidance of electric shocks in animals [93], and taste aversions in humans and animals typically occur after a single learning trial [94,95]. Likewise, evidence suggests that human phobias constitute innate predispositions, mirroring the biological preparedness of the organism to avoid negative events [96]. More evidence for the idea that the human nervous system is 'wired' to respond more strongly to negative events comes from psychophysiological research. Electroencephalogram studies have shown that negative compared to positive stimuli elicit larger event-related potentials in the brain [5,97,98].

internal affective reactions or motivational potentials [9]. Because similarity between pieces of information substantially influences all stages of cognitive processing [10–12], positive information's higher similarity is a viable alternative explanation for known valence asymmetries and allows predicting hitherto undiscovered phenomena. This perspective is in the tradition of influential researchers such as Egon Brunswik [13] and Kurt Lewin [14] who have argued that psychological theories often neglect 'external' explanations for psychological phenomena ([15,16], see Box 2).

In the following, we first illustrate the differential similarity of positive and negative information. We then provide an explanation for this similarity difference, and finally discuss how it can explain differences in the processing of positive and negative information.

Positive Information Is More Alike Than Negative Information

As noted by Leo Tolstoy in the opening of his novel *Anna Karenina*, 'Happy families are all alike; every unhappy family is unhappy in its own way.' Recent psychological research suggests that Tolstoy's observation even holds true in the broadest formulation that different pieces of positive information are alike whereas different pieces of negative information are negative in their own way. We argue that this similarity asymmetry is a robust and general characteristic of the environment humans live in, observable across various research domains, for which we provide examples in the following.

Facial Attractiveness and Prototypes

People judge faces with 'average', non-extreme features as more attractive, and they typically judge the morph of different faces more attractive than the individual faces [17,18]. Consequently, attractive compared to unattractive faces are more similar to one another [19]. More generally, people prefer stimuli that are similar to a given category's prototype. This holds for almost any category such as cars, fish, or birds [20], and extends to abstract stimuli such as dot patterns or geometrical configurations [21]. When stimuli become more similar to a prototype, they become more positive and they also become more similar to one another. Hence, perceptually 'good' stimuli are more alike than perceptually 'bad' stimuli.

Box 2. How the Information Environment Shapes Information Processing

In anticipation of what Garner [40] later called the 'extrinsic' world, Brunswik [13] and Lewin [14] argued that psychological processing always unfolds in a certain information environment. Further, psychological processing is fundamentally constraint by the properties of this information environment. In the environment, stimuli display certain 'objective' properties, which influence cognitive processing [15]. Such stimulus properties include frequency of occurrence as well as covariation of stimuli. The perspective of the information environment provides an alternative to mainstream psychological theories that are mainly concerned with internal processes such as affective and motivational states or cognitive resources [16]. Neglecting the influence of the information environment may lead to misleading conclusions whereby an externally caused phenomenon is falsely attributed to an internal process such as affect or motivation.

For example, while it has been argued that negative information receives greater weighting in judgments because of internal affective reactions, negative information is also rare. Because rare information is less redundant and thus more informative, it should receive greater weighting during the formation of a judgment [76]. Another example for the important role of the information environment is the greater psychological impact of monetary losses over wins [99]. Beyond internal affective reactions they elicit, real-life gains typically come in greater chunks (monthly income) than real-life losses (daily payments). Consequently, monetary losses appear larger compared to how they typically present themselves in the environment [100]. Another prominent example for how properties of the information environment contribute to phenomena that are typically explained by internal affective and motivational accounts regards the derogation of minority groups. That is, encountering a minority group member and encountering a negative behavior are both rare events in daily life. The joint distinctiveness of minority members who behave negatively was shown to create the illusory perception that minority group members behave more negatively than majority group members, beyond any affective and motivational forces [101,see also 102,103].

We identify another characteristic of the information environment, namely, that positive information is more similar than negative information. We suggest that this asymmetry can account for some psychological phenomena that are typically explained by affective or motivational forces.

Person Perception and Attitudes

The same principle applies more generally to attitudes people hold about other people or objects. For example, when people rate persons they know on personality dimensions, they assign highly similar ratings to different liked persons, while the ratings they assign to different disliked persons are rather diverse [22]. Consequently, people perceive liked others as more similar than disliked others [23]. Positive attitudes also display a greater inter-rater agreement. That is, raters who like a given target person produce highly similar rating profiles, while raters who dislike given target persons produce diverse profiles [24]. Similarly, people agree about their reasons for liking a certain ice cream, but they disagree about their reasons for disliking another ice cream [25]. Thus, as different people's attitudes about different attitude objects become more positive, these attitudes also become more similar.

Language

The similarity asymmetry is also inherent in the semantic structure of language: Positive words are more similar to one another than negative words. When participants were asked to provide pairwise similarity ratings of positive and negative words frequently used in social–cognitive research [26,27], positive words were judged as much more similar [28,29]. Recent research has shown that this effect generalizes to large samples of word stimuli [9]. When analyzing words from a large database [30], as well as several thousand words sampled by participants, positive words were always judged as more similar compared to negative words, across different measures of similarity. The same applies to verbal descriptions of positive and negative life events. When participants named one positive and one negative 'event of the day' across 7 consecutive days, they judged positive events as more similar than negative events [9].

Beyond subjective similarity ratings provided by participants, similarities between word stimuli can also be assessed based on their objective co-occurrence frequencies [31,32]. Similar words tend to co-occur in the same context. In line with the present argument, positive words do in fact more frequently co-occur on the same Web page and on the same book page [9]. Noteworthy, frequency of co-occurrence as an index for similarity was found to be highly correlated with subjective similarity ratings, which suggests that positive information's higher similarity might in fact be a 'true' property of the information environment.

Similarity As an Explanatory Construct

In sum, across different domains of psychological research and across different stimulus domains, positive information is more similar than negative information. However, some researchers have questioned the usefulness of similarity as an explanatory construct for cognitive processing. The main argument is that stimuli may be similar to one another in different respects and global similarity judgments are therefore highly context dependent [33]. By contrast, global similarity measures typically show high interrater agreement, and the correspondence between different similarity measures is also high [34–36]. In addition, these measures reliably predict various cognitive parameters such as processing speed, categorization, generalization, or memory performance [37–39]. While there are theoretical and empirical challenges for a global construct of similarity, its predictive power provides a pragmatic justification. The same arguments also hold for the here proposed higher similarity of positive information: regardless of the specific similarity measure, the specific stimulus aspect, or the stimulus domain, positive information seems to be more similar than negative information, and this higher similarity reliably predicts processing outcomes as we will discuss later.

Why Positive Information Is More Alike Than Negative Information

The question remains 'why' this asymmetry exists and whether it is a feature of the cognitive system or a feature of the ecology (see Outstanding Questions). The first position follows from the affective or motivational potential of evaluative information (Box 1). Accordingly, confrontation with a negative stimulus elicits negative affect, which triggers deeper processing, resulting in a more differentiated mental representation. However, we argue that positive information's higher similarity is a true property of the information ecology, independent of affective and motivational influences. Our idea follows the tradition of researchers like Brunswik [13], Lewin [14], and Garner [40], who emphasized the importance of the information ecology for psychological processes.

Our explanation for positive information's higher similarity builds on the well-documented assumption that valence is a function of attribute extremity. Aristotle [41] already recognized that desirable qualities are modest qualities that are framed by both excess and defect. That is, a positive range is located toward the middle of a given attribute dimension and is surrounded by two negative ranges toward the two ends of the dimension. Thereby, positivity is non-extreme. This is apparent at the most basic level: Human life is possible only within a single range of temperature, oxygen concentration, solar radiation, and so on. For most physical and chemical dimensions that are relevant to human life there is a 'too little' and a 'too much'. While humans can survive within a 'good' temperature range, they can both freeze and burn. The same principle applies to internal biological states as prominently expressed in the concept of homeostasis [42,43]. As discussed earlier, the perceptual system follows the same principle, as the desirable range of prototypicality is surrounded by various deviations from the same.

Importantly, the range principle is also ubiquitous in psychological domains. Grant and Schwartz [44] showed that for virtually all dimensions of human attributes, the positive or desirable range is non-extreme. Even on attribute dimensions that seemingly have one positive and one negative pole, the positive range reaches inflection points at which its effects turn negative. Agreeableness turns into conformity, conscientiousness into perfectionism, and courage into recklessness. Consequently, desirable personality profiles are those that are non-extreme, which is why the correlation between item means of personality tests and item desirability typically exceeds $r = 0.80$ [45]. Recent research has shown that the range principle also underlies the mental representation of social groups [46,47]. That is, likeable social groups are those that are non-extreme regarding their agency and their beliefs, while non-likeable groups are those that are extreme on these dimensions.

Of course, some qualities might be linearly related to valence. For instance, the amount of poison in one's blood, or the amount of traumatic experiences one has had. However, those are exceptions to the rule that attribute dimensions typically host one (non-extreme) range and two (extreme) negative ranges, constituting an inverted u-shaped relation between attribute value and valence. Furthermore, the reverse pattern seems even more unlikely and maybe even never occurs; that is, attribute dimensions that host one (non-extreme) negative range and two (extreme) positive ranges (but see Outstanding Questions).

Assuming that attribute dimensions typically host one positive range framed by two negative ranges, it follows that positive information must be on average more alike than negative information. The possible maximum distance between the two negative ranges on a given attribute dimension always exceeds the distance within the positive range. While two positive stimuli necessarily have to lay within the same range, two negative stimuli can lay in two different ranges on a given attribute dimension that are highly distant and therefore different from each other. For example, while two attractive men must display a height that lays within the same desirable range, two unattractive men can either be too short or too tall, and thereby highly different.

Figure 1 (Key Figure) illustrates the range principle in a two-dimensional attribute space in which proximity equals similarity in accordance with a geometric model of similarity [9]. The single positive space emerges in the center (white square), surrounded by four distinct negative spaces (dark gray squares) and four ambivalent spaces (light gray squares). If one would randomly sample pairs of positive and negative stimuli and locate them in the attribute space, the positive stimuli will be on average located closer together than the negative stimuli.

Preponderance of Negative Concepts

Beyond explaining the similarity asymmetry, the range principle implies a larger number of negative states, even on a single attribute dimension (cf. Figure 1). Evidence for this implication comes from research showing that language includes more negative than positive concepts. For example, the majority of words that can be used to describe a person are negative, which has been shown for the English and German languages [48–50]. The same is true for emotion-related words in general, as the ‘working emotion vocabulary’ in English and Spanish was found to include more negative (50%) than positive (30%) words [51,52]. An analysis of English ‘verbs’ also revealed a preponderance of negative over positive words [53]. It is unclear to what extent the preponderance of negative words applies to languages in general as we are not aware of research investigating the number of positive and negative words in languages other than English, Spanish, and German.

The implied larger number of negative states is also found in humans’ emotional response repertoire. While different researchers have proposed different ‘basic emotions’, almost all describe more distinct negative than positive emotions [54]. For example, early conceptualizations by William James [55] included fear, grief, rage, and love. Later, Ekman and Friesen [56,57] prominently identified anger, disgust, fear, sadness, and joy as basic emotions, and Panksepp [58] described the psychobiological systems of fear, rage, and panic and an appetitive expectancy system. How preponderance of negative emotions follows from the range principle can be illustrated using appraisal theories of emotions [59]. Accordingly, positive emotions result from goal-congruent appraisals, while negative emotions result from appraisals of goal incongruence [60]. Again, while goal congruence constitutes a single condition, there are many different ways

Key Figure

Illustration of the Range Principle and the Resulting Higher Similarity of Positive Information in a Two-Dimensional Attribute Space.

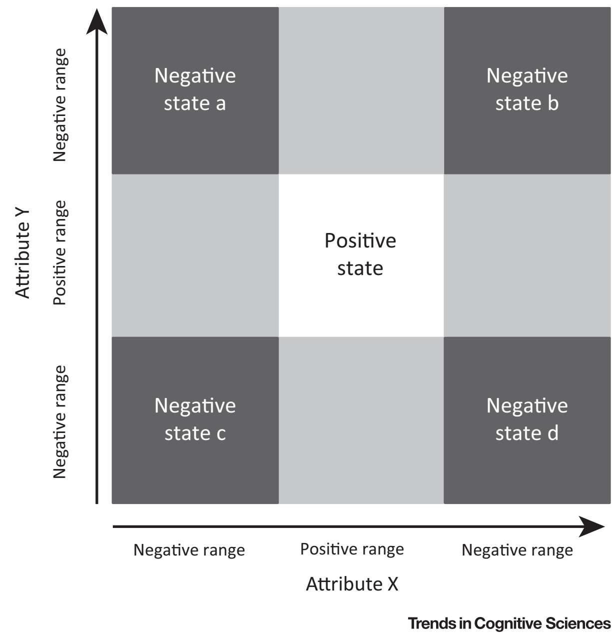

Figure 1. The assumption is that valence is a function of extremity; extreme attribute manifestations are negative, non-extreme manifestations are positive. The two attribute dimensions X and Y therefore host one (non-extreme) positive range framed by two (extreme) negative ranges. This results in one positive state (white square) and four distinct negative states (dark gray squares). Two positive stimuli must be located within the same single space and are therefore on average highly similar to one another regarding attributes X and Y. Two negative stimuli, by contrast, can be located in two different negative spaces, which means that they are on average less similar to one another.

for conditions to be goal incongruent. From this perspective, the manifoldness of the negative emotional repertoire mirrors the great diversity of goal-incongruent conditions.

In sum, the differential similarity of positive information and negative information may follow from the proposed range principle. We believe this explanation is plausible and parsimonious, without denying that there might be other factors contributing to this asymmetry in similarity (see Outstanding Questions). Besides being an intriguing phenomenon by itself, positive information's high similarity may serve as an explanatory construct for differences in the processing of positive and negative information, which we address in the following.

Implications of Positive Information's Higher Similarity for Cognitive Processing

As discussed, valence asymmetries in cognitive processing are often explained by the stronger affective or motivational potential of negative information, which triggers deeper and more elaborate processing ([8], Box 1). Here, we discuss how positive information's higher similarity may account for a number of well-known valence asymmetries. We argue that these asymmetries occur not because 'bad is stronger than good' [7], but because good is more alike than bad. Some of our suggestions remain speculative at this point, others based on research that empirically disentangled the two explanations by simultaneously using stimulus valence and interstimulus similarity as predictors for cognitive processing.

Attention

Negative information attracts more attention [3,61]. This seems reasonable assuming that denoting special attention to potentially harmful stimuli is adaptive and constitutes a survival advantage for the organism (Box 1). However, research has shown that new or nonprototypical information also attracts more attention [62,63]. As argued earlier, negative information, such as different descriptions of unethical behavior, pictures of accidents, unpleasant noises or smells, come in many different shapes and forms and is thus less likely to resemble any prototypes. The nonprototypicality of negative information might thus account at least for some portion of its attention-grabbing potential. The use of physiological measures such as electroencephalogram may provide a fruitful tool to test this idea. If negative information draws more attention because it is nonprototypical, it should be especially likely to exhibit event-related potentials associated with surprise [see 64].

Categorization and Generalization

Information is structured into categories, based on exemplars' similarities and differences. Rosch and Lloyd [65] prominently remarked that categories are formed so that within-category similarities and between-category differences are maximized. Assuming that positive information is highly similar, we expect positive categories to be broader and less numerous. In a recent investigation, participants were asked to sort representatively sampled positive and negative words into different categories of their own choice [9]. As predicted, participants created a 'smaller' number of positive categories that hosted a 'larger' number of words. Applying this principle to attributes, we can also expect that positive attributes elicit broader generalizations to other positive attributes. Formally speaking, among positive attributes compared to negative attributes, the presence of an attribute A is more indicative of the simultaneous presences of an attribute B. This prediction has recently been supported by research in the domain of person perception [66]. Positive compared to negative trait concepts show much stronger halo effects, which describes the tendency to infer the presence of a trait B based on the presence of a trait A. For example, while social perceivers expect an honest person to be industrious, they do not expect a liar to be lazy.

More generally, the superordinate category 'positive' should be more homogenous, that is, consisting of more homogenous exemplars than the superordinate category 'negative'. This becomes relevant in reaction time-based procedures that use positive and negative stimuli to measure attitudes. Widely used procedures such as the Implicit Association Test [67,68] or evaluative priming tasks [69,70] aim at measuring the associations between given categories of interest (e.g., gender, race) and the general concepts of positivity and negativity. In these tasks, exemplars of categories of interest (e.g., pictures of women and men) are paired with exemplars of the categories positive and negative (e.g., pleasant and unpleasant pictures). If positive exemplars are indeed more similar and thereby better resemble the superordinate category 'positive', measures of positive attitudes should be more reliable than measures of negative attitudes. The large diversity of negative stimuli produces more error variance. This is in fact what research using the Implicit Association Test and other association measures has found. Measures of positive compared to negative attitudes show higher reliability and criterion validity [71–73]. Measuring negative attitudes seems to constitute a challenge because negative attitudes are manifold.

Information Integration

When humans integrate information in order to form a judgment or derive at a decision, different pieces of information are weighted differently [74], and people seem to denote more weight to negative information [75–77]. Most of the evidence for this effect comes from the person perception domain. For example, an equal number of positive and negative person characteristics evokes an overall negative impression. Again, a straightforward interpretation of this negativity dominance is that negative characteristics are potentially harmful, and therefore elicit stronger affective and motivational reactions within the individual (Box 1). For example, it has been argued that a person's negative characteristics are more relevant for a perceiver's self-interests than a person's positive attributes [78]. However, other researchers have provided alternative explanations that go beyond perceivers' self-related affective and motivations reactions. For example, negative compared to positive behaviors are usually more diagnostic of a superordinate trait category [77]. In addition, negative person characteristics apply to less people than positive ones, and are therefore more informative [76]. The more prevalent a given attribute is among the population the less it differentiates a person from other people. Because of its higher frequency, positive person characteristics are therefore more redundant.

A different kind of redundancy results from positive information's higher similarity. Because positive information is more similar, it is also more redundant. Thus, individual pieces of negative information such as different descriptions of a person's bad behaviors might be weighted more strongly in forming a judgment because they are less similar and therefore less redundant compared to different descriptions of a persons' good behaviors. In other words, negative characteristics constitute unique variance in targets' behaviors.

Processing Speed

An important characteristic of information processing is speed, and it seems that positive information is processed faster than negative information. For example, happy faces including schematic ones are identified more quickly than unhappy faces [79,80]. The same holds for word stimuli. For example, people are faster to name colors of words that represent desirable compared to undesirable traits [4]. Similarly, in evaluative priming procedures, participants are faster at classifying a positive target stimulus preceded by a positive prime, compared to a negative target stimulus preceded by a negative prime [28]. That processing of negative information is more time-consuming fits well with the idea that negative information undergoes deeper processing as the result of affective reactions (Box 1). However, among evaluative stimuli typically used in reaction time-based experiments, positive stimuli were shown to be more similar to one another [28]. Crucially, in a simultaneous regression analysis, interstimulus similarity completely accounted for the effect of valence on categorization reaction times. This suggests that what is slowing down the processing of negative information is not its valence-based affective potential, but its diversity.

Recognition Memory

Negative information also enjoys an advantage over positive information in recognition memory. Specifically, a number of researchers have shown that negative word stimuli are more accurately recognized in old–new recognition paradigms because they elicit less false alarms than positive stimuli [6,81]. These authors also suggest that negative information's memory advantage is due to affect-induced deeper processing of negative information (Box 1). Given that deeper encoding increases recognition performance [82], this interpretation seems plausible. Yet, recent research has shown that negative stimuli are more accurately recognized than positive stimuli because they are less similar [83]. The authors first replicated the standard memory asymmetry effect and then found in a simultaneous regression analysis that this effect was completely accounted for by interstimulus similarity and that stimulus' valence had no unique influence on memory performance. Second, the authors created stimulus sets in which positive word stimuli were more diverse than negative ones. In this condition, positive stimuli were more accurately recognized than negative ones. These findings are in line with a large body of research showing that interstimulus similarity increases false alarm rates in recognition and thereby decreases recognition accuracy [37,38,84]. In other words, because positive stimuli are typically highly similar, they create strong memory confusion and elicit a high rate of false alarms.

Concluding Remarks and Future Perspectives

There is ample evidence that affective reactions within the individual alter information processing (Box 1). Specifically, negative affect triggers deeper and more elaborate processing. Affective and motivational explanation are therefore viable candidates to explain differences in the processing of positive information and negative information. However, we suggest that processing asymmetries may also be due to structural properties of the information itself (Box 2). Specifically, positive information is more similar than negative information, which should influence various stages of cognitive processing.

We argued that the higher similarity of positive information is a true property of the information environment that humans live in. We further argued that it results from the non-extremity of positive qualities. Most attribute dimensions host one (non-extreme) positive range, which is opposed by two negative ranges; therefore, positive stimuli or positive information in general must be on average more similar. Further, because similarity between pieces of information strongly influences processing, a number of valence asymmetries follow.

Obviously, affective-motivational forces may cause valence asymmetries independent of the influence of similarity. The influence of affective states on cognitive processing is well-established and this influence might exert itself when humans process positive and negative information. Certainly, more research is needed to fully de-confound affective and similarity-related influences in the processing of positive information and negative information. Two different methodological strategies can be used: First, when testing for the influence of affective reactions toward positive and negative stimuli, interstimulus similarity should be controlled for. The second strategy is to measure both valence and similarity of the stimuli used. This strategy has the advantage that it allows a direct test of affective and similarity influences on information processing. Given that a stimulus' valence is a proxy for its affective potential, affect-related processing asymmetries should be a function of stimulus valence (see Outstanding Questions). Thus, by including valence and similarity measures in an empirical design, researchers may detect affective and similarity influences on criterion variables such as processing speed, attention allocation, or memory performance.

We believe this new look on valence asymmetries in cognitive processing is a fruitful endeavor and will substantially refine our understanding of how humans process positive and negative information.

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Outstanding Questions

Why do most attributes display only a single range of positivity but two distinct ranges of negativity? Why are extreme attribute manifestations usually negative? There are only a few exceptions to this rule where extremity is linearly related to valence. For example, the amount of poison in one's blood. However, there seem to be virtually no attributes for which both extreme ranges are positive and the moderate range is negative. Are there situational or organismic states that can create such a scenario? If repeated exposure to a stimulus at some point elicits boredom, would then any deviation from this stimuli's properties be perceived as positive?

Is positive information always more similar than negative information or are there cases in which the reverse is true? Are there domains for which there are many ways to be positive but only a few ways to be negative? Some stimulus domains may by definition include restrictions that limit the diversity of negativity. For example, food refers to organic material that is eatable and a person might like a whole variety of different foods while he or she dislikes only one specific kind of food (e.g., fish).

How can one assess whether positive information is *a priori* more similar than negative information, that is, before it enters the information-processing individual? This requires objective measures of similarity that do not rely on subjective participant ratings. While in the domain of face and object perception, liked stimuli are objectively more similar regarding physical properties such as nose length or ear size, objective measures for the similarity between words remain a challenge. One approach is to measure the frequency of co-occurrence among pieces of positive and negative information in the environment. Indeed, positive compared to negative word pairs objectively co-occur more frequently on the same book or Web page. Still, future research should attempt to develop other objective indices of interstimulus similarity.

How can the influences of similarity and affective reactions on information processing be disentangled? On the stimulus level, similarity can be measured as well as valence. However, is valence a good index for a stimuli's affective potential? Are there stimulus properties

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related to more specific emotions and motivations that are better predictors for processing asymmetries? Further, affective reactions are not only characterized by valence but also by physiological arousal. Would a combined measure of a stimuli's valence and the arousal it elicits constitute a better index for affective potential? Does similarity account for differences in the processing of positive and negative information over and above valence, arousal, and measures of more specific emotions and motivations?

Which valence asymmetries are caused by affective and motivational influences and which are caused by informational influences such as similarity? Under which conditions is the affect elicited in the individual strong enough to influence information processing? While positive and negative words might not elicit strong affective reactions, pictures or real-life situations might.

Do differences in the processing of positive and negative information disappear after participants are repeatedly exposed to the same information? Some empirical evidence suggests that the stronger affective potential of negative information decreases over time. Accordingly, after an initial strong mobilization of the organisms in response to a negative stimulus, the organism employs several mechanisms in an attempt to minimize the long-term effects of negativity. When negative information loses its stronger potency over time or due to repeated exposure, affect-related processing asymmetries should vanish as well. Similarity-related asymmetries, by contrast, should remain stable because similarity constitutes a structural property of the information itself.

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