11 Striving for Certainty

Epistemic Motivations and (Un)Biased Cognition

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Introduction

In this chapter, we will focus on how the quest for certainty drives cognition and thereby affects knowledge formation and usage. Traditionally, this quest has been linked to closed-minded cognition, that is, to forming rigid knowledge and belief systems resistant to change (Kruglanski, 1989). Closed-mindedness leads people to believe they are in possession of an absolute truth, which is why they uncritically ignore, discount, or reject evidence that is discrepant with their important beliefs (usually linked to identity). This usually drives inaccurate and biased cognition and implies a tendency to maintain in one's mind a single perspective along with the conviction of its unquestionable correctness, which results in the rejection of other perspectives. This also leads to knowledge resistance, that is, a failure to accept available and established knowledge.

The motivation to achieve certainty is however not always associated with closed-minded (and biased) cognition, and in this chapter, we will put forward an alternative view to account for this. More specifically, we claim that the quest for certainty is a goal that can be attained by various means. They may be chosen from among a range of means, either biased, identity-protective, or accuracy-oriented cognitive strategies, depending on how useful (i.e. instrumental) these means are perceived to be for the overarching goal of epistemic certainty. Epistemic certainty about the past and present state of the world refers to what we know. Epistemic uncertainty however arises because of what we do not know but could know in theory (e.g. uncertainty due to limitations of the sample or methodology) (van der Bles et al., 2019). When identity-protective strategies are adopted, the beliefs that a person holds remain unchanged, or even strengthened due to rejection of claims with good evidence against one's view or endorsements of claims with no credible evidence that support ones' beliefs/identity. However, when accuracy-oriented strategies are adopted, existing beliefs may be altered by the incoming information. This implies the capacity to retain diverse perspectives in one's mind, to accept their diversity and their critical overview. In consequence, it becomes possible to change one's beliefs and judgements whenever new and more credible information is revealed.

Cognition is Motivated[1]

The construction of new knowledge is a persistent human activity. For activities ranging from the relatively simple and mundane to the highly complex, new knowledge is essential to assure confident decisions and reasoned actions. Given the prevalence of the knowledge formation process, and its essential psychological relevance to human thoughts, feelings, and actions, understanding how knowledge is formed and changed, is a task of considerable importance for psychological science (Kruglanski, 2004). According to Lay epistemic theory (Kruglanski, 1989), contrary to popular belief, individuals do not gather information in a chaotic and random manner. Research has rather shown that knowledge formation is a process of hypothesis generation and validation, which is quite orderly and follows logical rules, such as "if – then", from premise to conclusion (Kruglanski et al., 2009). The conclusion is knowledge, an opinion, a belief, or a judgement. This process occurs regardless of the quality of the information acquired (evidence may be reliable or unreliable). It also occurs regardless the engagement of the person involved (one may wish to know what the truth is, or simply to confirm their initial expectations). It emerges in each case when an individual learns of something that is sufficiently important to initiate the motivational process that underlies cognition.

Kruglanski et al. (2009) demonstrate that the manner in which people generate hypotheses is reliant on cognitive resources. These may be modified by exhaustion and by people's readiness to engage in cognitive activity. The more cognitive resources available, the more alternative hypotheses could be generated. However, cognitive exhaustion (e.g. several activities are being conducted at once, too much similar information is being given, or even information chaos is present) or high epistemic motivation (i.e. the desire to develop and maintain a rich and thorough understanding of a situation) usually limit the scope of the hypothesis generation process. As a result, people tend to bring up a low number of hypotheses about the event.

However, the process of hypothesis validation depends on prior knowledge and its level of activation, plus the quality and strength of evidence available. These factors work together in shaping the processes of selection and evaluation of information, and in effect, the adoption or rejection of a hypothesis, and thus the formation of knowledge. A further factor that plays a crucial role here is epistemic motivation. This factor affects the degree of confidence in one's knowledge and influences the propensity to continue or stop searching for information. It also impacts decisions concerning which information can be considered "evidence". It shapes readiness to update one's beliefs in the light of emerging new evidence (Kruglanski et al., 2009). This epistemic process may manifest in knowledge resistance or openness to its update based on credible evidence.

Epistemic motivation is usually initiated under uncertainty, i.e. when there is a lack of information (or there is access to merely low-quality, incomplete or conflicting information) about whether, where, when, how, or why an event has

occurred, or will occur (Knight, 1921). Uncertainty could be reduced by means of the acquisition of precise, unambiguous knowledge of the specific content of one's beliefs and preferences (or regardless of their specificity). Thus, this type of motivation influences different epistemic behaviors, including the active search for information that is subjectively considered relevant and valid. Such information could serve as "evidence". The behaviors initiated under epistemic motivation can also encompass the active avoidance of information subjectively considered nonrelevant or nonvalid. In addition, epistemic motivation itself can generally be classified into two kinds: the need for nonspecific certainty, and the need for specific certainty (Kruglanski, 1989). Whereas the former reflects the need to possess any certain answer on a topic (e.g. whether vaccination against Covid-19 is safe and effective), the latter refers to the need to attain a concrete judgement, opinion, and/or assessment (e.g. that the vaccination against Covid-19 is indeed safe and effective). The need for specific certainty has an influence on cognition which has often been interpreted as a directional bias toward a favored conclusion (e.g. anti-vaccination advocates can interpret the side effects of vaccine as proof that they were right). Much classic motivational work in attribution (e.g. Miller, 1976) as well as cognitive dissonance (Cooper & Fazio, 1984) has been the focus of this particular motive.

Moreover, the primary assumption of a great deal of traditional work on motivated reasoning is that the whole process of knowledge formation is motivated by prior beliefs (Kunda, 1990). It has been suggested that people form their current beliefs based both on prior beliefs and the cogency of the new relevant evidence (Kruglanski et al., 2020). In this view, prior beliefs serve as (internal) models of (external) reality, and are used to make predictions about the world. However, any actions or perceptions are subject to optimization, and the explanations accounting for the new evidence need to be accurate as possible. Consequently, there are two ways of accounting for the new evidence: (1) updating one's model or (2) acting on and sampling evidence so that it fits with the model (Kruglanski et al., 2020). Taking the first of these paths, people construct mental models that enable them to predict and interpret subsequent experiences. It also provides them with a sense of understanding, even meaning (Proulx, Inzlicht, & Harmon-Jones 2012). Once adopted, people are committed to the models, but may also change them. This process is defined as a change of expectations toward new stimuli that renders them consistent with what was already known. In turn, the second process involved is one of accounting for new evidence which entails people tending to search for, interpret, favor and recall information in such a way as to confirm their preexisting beliefs or hypotheses (Nickerson, 1998). In this way, people may start out overconfident in an initial belief, fail to give proper consideration to alternative hypotheses, or interpret ambiguous information in favor of a firmly held belief (Klayman, 1995).

We now turn to the second class of epistemic motivation, the need for nonspecific certainty which reflects the need to arrive at any conclusion whatsoever that would serve the focal goal to achieve certainty (Kruglanski, 1989). In other words, the need for nonspecific certainty drives the possession of any opinion,

judgement, beliefs, regardless of their content. This knowledge needs to provide a sense of certainty, adequacy, and be subjectively sufficient to understand a given phenomenon. This type of epistemic motivation boils down to such things as (1) reducing the scope of information processing and hypothesis generation, (2) concentrating the process of seeking information on prototypical rather than diagnostic parameters, and (3) using the first available information. All these lead to the tendency to focus on evidence or facts that are presented earlier than others (*primacy effect*), and then to determine the other information from it (*anchoring*), as well as the activation of stereotypical content, and a preference for consensual and general knowledge (for an overview, see Roets et al., 2015).

According to Kruglanski et al. (2020), by taking into account the need for specific or non-specific certainty, we are in a position to explicate diverse epistemic phenomena, such as seeking, avoiding, biasing new information, and revising and updating, or protecting, one's beliefs when confronted with new evidence. These processes are crucial to understanding knowledge formation and its usage.

Cognitive Effects of the Need for Specific Certainty

One of the most documented effects of the need for certainty are confirmation or myside bias and disconfirmation bias (for an overview, see Nickerson, 1998). The first phenomenon occurs when people accept evidence confirming their (important) beliefs without criticism, whereas the latter occurs when people try to undermine the evidence contrary to their beliefs. It follows that one type of evidence that might be perceived as supporting one's stances is mixed findings. In a classic study, Lord et al. (1979) found that people were more skeptical toward research that presented conclusions which were inconsistent with their beliefs (about the efficacy of the death penalty as a deterrent to murder). Specifically, people perceived the studies presented as more reliable and convincing, when the results therein were in support of their own stance on the topic compared to those that were not. Intriguingly, the study methods themselves were presented to participants after the procedures were completed. The authors called this process *biased assimilation*. They concluded that, as a result of this process, when people are provided mixed, inconclusive, or random evidence, *biased assimilation* leads to a further polarization of opinions. Similarly, in a study by Ditto and Lopez (1992; Studies 2–3), when people were presented with the undesirable (vs. desirable) results of a medical test, it took them longer to decide whether their test result was complete, they were more likely to retest the validity of their result, and rated test accuracy lower. This indicates that people were less skeptical of evidence that was provided to them with desirable vs. undesirable information. Another study looking at the effects of mixed evidence was that of Bastardi et al. (2011), who analyzed responses to scientific evidence from would-be parents who deemed home care to be superior to day care with regards to a child's future prospects. They compared two groups: *conflicted parents* (who were planning to use day care, although convinced that home care is superior)

and *unconflicted* ones (who were planning to use home care only). Participants were presented with two studies with different research designs (either randomly assigned, or statistically matching the sample) showing evidence for the superiority of one form of childcare or the other. The parents' evaluation of the studies' methodology favored the study that supported their desire (day care for the *conflicted;* home care for the *non-conflicted*) but the effects were stronger for the conflicted group. Also, people in the *conflicted* group changed their beliefs about day care dramatically on being provided with the (mixed) evidence. Those in the *non-conflicted* group changed their opinion only slightly. The authors concluded that "evaluations of purported scientific evidence were shaped more by what participants desired to be true than by what they had initially believed to be true" (p. 732).

These findings illustrate how prior beliefs influence knowledge formation. However, not all beliefs are valued to the same extent. Hence, not all beliefs exercise the same power to drive cognition. The sorts of beliefs that especially influence the way people search for and process information are those that are directly linked to their identity, both personal and social. Indeed, there is mounting evidence to suggest that identity-relevant beliefs are more than just tools to achieve external goals. Rather, these beliefs are a source of value in and of themselves, such that people are motivated to hold particular beliefs. For example, people generally prefer to believe they are correct rather than incorrect, they prefer to believe the future is bright rather than dark, and they prefer to hold beliefs with certainty rather than uncertainty. The researchers propose that the more identity-relevant a perception of behavior, the more likely functional these beliefs are, thus, the more successful self-regulation will occur. It is worth highlighting here that there is an overlap of brain regions involved in self-related and reward processing, which is in line with a suggestion that behavior or information that is self- or identity-relevant would have high subjective value (Berkman et al., 2017).

A vast body of research has demonstrated that beliefs related to social identity hold greater subjective value than beliefs irrelevant to this identity (Ellemers et al., 2002). This stems from findings that while personal identity informs the beliefs that are important to oneself (for instance, related to being tall, belief in one's proficiency in foreign languages or intelligence), social identity refers to a person's knowledge pertaining to their belonging to a social category or group (Hogg & Abrams, 1988). The social categorization of self and others generates a sense of in-group identification and belonging. It regulates perception, inference, feelings, behavior, and interaction to conform to the best representation of a given category (to prototype-based knowledge) one possesses about one's own group, and relevant outgroups. Moreover, because group prototypes and representation are shared ("we" are like this, "they"'are like that), one's world view and self-concept are consensually validated by the overt and verbal behavior of fellow group members. Social categorization thus makes one's own and others' behavior predictable, and allows one to avoid harm, plan effective action, and know how one should feel and behave. Thus, under uncertainty,

being motivated by the specific need for certainty, people become more involved in identity defensive cognitions (e.g. the right-wing adherents tend to be stricter and surer about abortion ban when uncertainty is present). This is especially the case when taking into consideration evidence that is suffused with culturally divisive meanings. In these circumstances, the pressure to adhere to group-congruent beliefs will often dominate over 'the right answer' standpoint (Kahan, 2017). Thus, espousing and holding beliefs that are aligned with one's social identity is a higher priority than achieving accuracy. The latter is too inconsequential a motive to affect the level of risk that a person faces, or to determine the outcome of any public debate. However, the consequences of getting the 'wrong answer' in terms of what is expected by members of the affinity group, are much more serious for the person, ranging from a loss of trust among peers to stigmatization within their community. Indeed, Kahan (2017) claims that social incentives for holding and expressing beliefs that are congenial to ones' group are almost invariably of higher value than producing accurate responses in most instances.

Still, it is worth noting that uncertainty itself, and various sorts of threats posed to one's identity, make the protection of identity-relevant beliefs stronger. An interesting example comes from a study by Rothmund et al. (2015), showing that when an important value is put in jeopardy (e.g. by informing pacifists about real-life violence), people are more likely to believe in scientific and political claims regarding any further threat to this value (e.g. that violent games are harmful). Colombo et al. (2016) looked into the role of morality in the perception of scientific hypotheses. They found that when a scientific hypothesis is offensive to one's moral values (e.g. hypotheses that attending religious services makes people healthier could be offensive to those who are dogmatic atheist, or that growing up with non-heteronormative parents lead to developmental disorders – to members of LGBT+ communities), then the assessment of the hypothesis is biased. Of interest is the fact that providing incentives (money) for more accurate evaluations did not improve subjects' accuracy, and these effects held even after controlling for the prior credibility of the hypothesis (e.g. when informed that the scientific community meets the scientific consensus about given hypothesis). Furthermore, Washburn and Skitka (2018) asked participants to interpret the results of the scientific evaluations of a public policy (e.g. CO_2 vehicle emission standards) and its conclusion. Although participants were informed about the correct interpretation afterwards, their ratings of agreement with these interpretations, the perception of being knowledgeable, and trust in the research's interpretation depended on their own political ideology. Significantly, both liberals and conservatives were not in agreement with interpretations of the scientific findings that contradicted their own beliefs. Also, Kossowska et al. (2017), studying religious orthodoxy, demonstrated that the threat posed by value-violators (e.g. atheists) leads to negative attitudes toward these groups among highly religious people. In this case, experienced threat for the outgroup was operationalized by cardiovascular reactivity, i.e. heart rate (HR); the higher the HR index, the higher the threat. The results found that people who hold high (vs. low)

levels of orthodox belief responded with increased HR after they were exposed to atheistic worldviews. However, the authors observed decreased HR after the expression of prejudice toward atheists among highly orthodox participants compared to the control condition. They did not find this effect among people holding low levels of orthodox belief. Thus, the researchers revealed that prejudice, in fact, may serve as an efficient strategy to protect oneself from sources of threat. This reasoning is consistent with research suggesting that prejudice and discrimination directed toward members of groups that violate important values, norms, and traditions can be used to diminish (or resist) these groups' informational influence on the person. This further bolsters one's cultural worldview, and thus reduces threat levels (for an overview, see Burke et al., 2010). In a similar vein, across three studies, Kossowska et al. (2020) showed that ideology is linked to the misperception of politically sensitive facts (e.g. What percentage of all people who died in Auschwitz were Jews? or What percentage of Polish society are LGBT?). This was especially true under conditions conducive to a higher salience of political identity (i.e. during the outbreak of the Covid-19 pandemic). The researchers explain this effect by positing that politically-relevant facts, especially highly politicized facts which are associated with membership in a political group, trigger the goal of protecting one's identity. As with other social-identity processes, ideology powerfully motivates perceptual processes toward making assessments in line with beliefs held by one's group (and resisting, i.e. ignoring or discounting, information in opposition to the beliefs held by the group). Other researchers also claim that shared ideological commitments intertwined with membership in groups furnish these individuals with important forms of support – emotional and psychological as well as material (e.g. Green et al., 2002). If a proposition about some policy-relevant fact comes to be commonly associated with membership in such a group, the prospect that one might form a contrary position can threaten one's standing within the group. Thus, these individuals may be motivated to resist empirical assertions (e.g. that gun control reduces or does or does not reduce crime), if they run contrary to the dominant belief within their groups. Thus, individuals may display the facts as negligible in their impact provided that the assessments (however wrong) are in line with their group commitments. Of note is the finding that the effects of identity on information processing are observed under uncertainty conditions which are conducive to a higher salience of political identity. Uncertainty may lead individuals to display a strong tendency to conform their understanding of different issues, especially complex ones, in accordance with the position of the authorities, or groups that they support or belong to (e.g. Kahan, 2017). This stems from the fact that uncertainty (threat, anxiety, and related negative feelings) causes ideological identity to become more salient, and in that fashion, identity-related beliefs shape social perception. Erroneousness that individuals may display regarding the facts is seen as negligible in its impact provided that the assessments (however wrong) are in line with their group commitments. Of note is the finding that the effects of identity on information processing are observed under uncertainty conditions which are conducive to a higher

salience of political identity. Uncertainty may lead individuals to display a strong tendency to confirm their understanding of different issues, especially complex ones, in accordance with the position of the authorities, or groups that they support or belong to (e.g. Kahan, 2017). This stems from the fact that uncertainty (threat, anxiety, and related negative feelings) causes ideological identity to become more salient, and in that fashion, identity-related beliefs shape social perception.

Although most of the studies demonstrated the negative effects of identity protective cognitions on accurate perception, judgments, and attitudes, it should be pointed out that there is some evidence showing that, under certain conditions, identity bias can be reduced or even overcome. For example, prompting an accuracy goal to reach a correct conclusion can elicit greater cognitive effort toward that goal, which can be translated into accurate cognition (e.g. Baumeister & Newman, 1994). Other studies show that identity-biased cognition is reduced when people are asked to form accurate opinions about a policy (Bolsen et al., 2014). Also, curiosity toward science was shown to reduce partisan polarization around science. Hence, people with high levels of curiosity about science were willing to consume news that was not in line with their political identity (Kahan, 2017). Similarly, helping people to realize their own ignorance about policy details – known as the explanatory depth illusion – can reduce political polarization; by contrast, derogating your political opponents tends to increase polarization (Fernbach et al., 2013; Suhay et al., 2018). Finally, Porter and Schumann (2018), investigating intellectual humility (i.e. recognizing the limits of one's knowledge and appreciating others' intellectual strengths), experimentally demonstrated that this factor could contribute to disagreements becoming more constructive. Specifically, it turned out that making salient a growth mindset of intelligence (i.e. by asserting that intelligence can be developed) boosted intellectual humility and in turn, openness to opposing views.

Cognitive Effects of the Need for Non-specific Certainty

The need for non-specific certainty implies the search for a firm, precise answer to a question, regardless of its specific content. Thus, under this motivation one just wants to know, rather than confirm a specific belief. Many studies have demonstrated that the motivation to attain certainty can psychologically manifest in the vigilance used to detect threats and opportunities. It also unfolds in impulsive reactions, wherein a person responds rapidly, with little deliberation (e.g. one makes a decision based on scarce, readily available information instead of engaging in a more extensive search). It also manifested in the capture of any immediate benefits, even when greater benefits could be obtained later (Jonas et al., 2014). This gives rise to a number of cognitive, motivational, and behavioral implications, including risk aversion, attentional biases, and impaired performance on a variety of working memory and decision-making tasks (e.g. Jameson et al., 2004). It also leads to narrow, selective attention focused on threatening stimuli that, under many circumstances, results in suboptimal performance

(Easterbrook, 1959; Kossowska, 2007). For example, a sizeable majority of previous studies have demonstrated that motivation to reduce uncertainty promotes simplistic cognition relying mainly on stereotypes and heuristics, that is, simple rules that lead to fast, yet at times suboptimal decisions (Kruglanski, 2004). Some studies have shown that people who are highly motivated to reduce uncertainty make more stereotypical judgments, prefer homogeneous over diverse groups, prefer consistent over inconsistent images, prefer realistic over abstract art, and prefer normative over deviant stimuli. Moreover, this motivation is related to heightened resistance to altering conclusions once drawn and greater reliance on the default mode of decision-making (for a review, see Roets et al., 2015). To conclude, under motivation to non-specific certainty, knowledge systems became rigid, closed to new evidence, resistant to change, and biased in the face of fragmented information.

While research clearly demonstrates the link between uncertainty and simplistic cognition, leading to biases and neglect of a large portion of important evidence, there are some contradictory findings, revealing that this motivation may also drive people to complex, effortful, and unbiased cognitions. For example, there is substantial evidence that people attend to novel, unexpected events that might disconfirm their expectancies but only when these events are relevant to their goals (e.g. when individuals desire to understand the event and be accurate in their cognition). Other studies have also shown that disconfirmations of important expectancies lead to increased attention to and processing of the inconsistent information. Additionally, people are willing to consider and incorporate new information in order to improve their predictive ability. This motivation can also foster an exploratory mode in which people tend to be open to, seek, and incorporate new information so as to be accurate or to avoid mistakes. These effects are reviewed by Kossowska et al. (2018).

A Goal (Versus Means) Perspective on the Quest for Certainty

So far, we have outlined the cognitive effects of the quest for certainty (specific or non-specific) that can be usually described as limiting openness for new evidence and thus biasing cognition. However, we have mentioned that this epistemic motivation, may also lead to more open-minded and unbiased cognition (i.e. all evidence is processed, regardless of their consistency with one's views). This dichotomy presents us with the challenge of distinguishing the conditions under which the quest for certainty leads to open-minded and when to simplistic, bias-prone cognition. Given the seeming necessity for theoretical refinement in this area, we have proposed a framework that allows for the re-examination of the abovementioned findings.

Specifically, we take a goal-means perspective and differentiate between the cognitive goals and means (i.e. actions) undertaken to satisfy these goals (Kruglanski et al., 2002). Goals represent *desirable states of affairs* to which attainment one is personally committed, and means are instrumental actions serving attainment of one's goals. We posit that the need for certainty (whether

specific or non-specific) is no different from any other goal. In this case, people aim to achieve certainty, they seek an answer to an important question, they desire to uphold a certain belief, and/or they wish to make confident decisions. These motivational states may initiate various epistemic actions to fulfill these underlying motives. For instance, people may consult other people's opinions to obtain external validation of their views, or they may simply depend on their own epistemic authority to form a confident judgment (Kossowska et al., 2018). Moreover, they may thoroughly scrutinize the attributes of all the available alternatives before making a decision, or they may be satisfied with choosing the first option that passes their personal threshold (Schwartz, 2004). While people will sometimes act skeptically and seek out information that contradicts their own knowledge, in other cases, they will actively avoid information if that helps them to protect a valued belief (Golman et al., 2017). Lastly, while they are sometimes ready to reach accurate conclusions, very often they form biased but identity-protective judgements (Kahan, 2017).

The above shows that even when the goal stays the same, (one wants to attain certainty (either specific or non-specific)), the means (cognitive strategies) can differ and, on some occasions, people select "closed-minded" means whereas, at other times, they opt for "open-minded" ones. And it is the distinction at the level of means, rather than goals, that determines whether people will resist the new or contradictory facts or let them influence their belief systems. This proposition has important theoretical and practical implications, as it allows for identifying conditions under which certainty-seeking individuals – otherwise prone to knowledge resistance – are more open to processing belief-inconsistent facts.

To this end, Kossowska et al. (2018) proposed that processing strategies, or means, are chosen according to their perceived instrumentality in accomplishing a particular goal, and their relations with other means and goals (Kruglanski et al., 2002). Instrumental means are ones that afford high probability (expectancy) of attaining a given goal with them (e.g. studying is an instrumental means to the goal of passing an exam, whereas partying is not) (Bélanger et al., 2016). In addition, a means is less likely to be chosen if it can be substituted by other means (i.e. equifinality), and is more likely to be selected if it serves additional coactivated goals (i.e. multifinality). A parallel line of research, in the cognitive neuroscience of motivation (e.g. Berridge et al. (2009), found that goal-directed behavior is associated with neuro-psychological states linked to wanting and seeking, and the activation of areas of the brain associated with reward processing (e.g. the cortico–basal ganglia–thalamic loop), as well as sympathetic nervous system reactivity (Gendolla et al., 2019). Together, these functions optimize goal striving and effort.

Following this thread of reasoning, Kossowska et al. (2018) proposed a model that allows clear predictions to be made about when and why people, epistemically motivated to reduce (non-specific) uncertainty, tend to perceive open-minded cognitive strategies as more instrumental than closed-minded strategies for reaching their goal of certainty. Specifically, the researchers suggested that this may happen when: (a) cues present in a situation suggest that open-minded

means are more useful for attaining the goal, (b) the closed-minded means are unknown or unavailable, or (c) general trust in closed-minded options is undermined. In an extensive research program, the researchers found support for these assumptions. For example, Jaśko et al. (2015) investigating decision-making processes, demonstrated that people motivated to achieve certainty searched for more information (i.e. they open more boxes with relevant information) before they made a decision and spent more time on decision-making than did those not in search of certainty, which attests to their openness to new information. What is more, it turned out that when a clue appeared in the task informing the participant of techniques conducive to its completion, people needing certainty followed it more frequently than those low in this need. In particular, when there was a clear rule by which seeking a greater amount of information turned out to be more beneficial in terms of goal achievement (i.e. participants were told that the majority of people open most boxes to attain high results), people highly motivated to achieve certainty engaged in information-seeking to a greater degree. These findings have important implications for understanding how certainty-seeking individuals process information more generally. Specifically, it suggests that they can be more open or closed (i.e. resistant) to new facts, depending on the situation. When, in a given context, there is a clue suggesting that certainty could be best attained when engaging in unbiased, more extensive information search (e.g. nudges prompting fact-checking or verifying information with different sources), people motivated to attain certainty will exhibit more "open" epistemic behaviors, even when this may lead to a change in their initial view.

A further example of a condition inducing open-minded cognition among people epistemically motivated to achieve certainty comes from the classic study by Kruglanski et al. (1991). The experiment they conducted showed that when the initial certainty of participants as to their decisions was high, the need for certainty was indeed associated with a lower amount of information being sought by the participants. However, when participants were not certain as to their initial decision, this epistemic motivation expanded the scope of data sought out.

An illustration of cognition occurring under conditions where general trust in closed-minded options is undermined comes from studies by Kossowska & Bar-Tal (2013). In this study, the researchers demonstrated that low trust in one's own capacity to achieve certainty may lead to cognition that is typically associated with openness, such as reduced bias in the formulation of impressions of others, the taking of complex decisions rather than simple ones, and reduced stereotyping. In addition, studies in which one's confidence in the previously obtained knowledge was experimentally undermined, these open-minded effects were also found (Dragon & Kossowska, 2019). In these situations, individuals lost faith in themselves and their knowledge, which, in turn, resulted in this knowledge (i.e. opinions, beliefs, stereotypes) no longer serving as the basis for formulating judgements, and ultimately led to it shedding its potential for guaranteeing certainty. As a consequence, the individuals were forced to employ alternative strategies to achieve certainty. Such a situation turns out to be particularly difficult for people for whom certainty plays a fundamental role. On the one

hand, they feel a strong need to obtain certainty, while on the other, they are deprived of their existing means of achieving it. This leads to them potentially being more motivated to revise their previous expectations and views, and to look for new information on a given subject. In other words, they can be more epistemically motivated to engage in open-minded cognition, and thus counteracting resistance to new and inconsistent facts.

Final Thoughts

The research mentioned above reveals that open-minded cognition is preferred (a) when a situation provides clues that "open" strategies are likely to be the most effective in achieving certainty, (b) when simplified inference is not possible, or (c) when people begin to doubt their previous modes of inference, whether this is a result of a threat to the self, the experience of a loss of power or control over the situation, or also when encountering credible (and by the same token impossible to ignore) information that is inconsistent with the individual's existing knowledge and previous experiences.

However, the focus of these research efforts was mostly devoted to describing fundamental cognition (and measured this at physiological and neuropsychological levels). Thus, the open cognition that the researchers focused on refers to the readiness to select more complex, difficult, and effortful cognitive activity. It may include: seeking out new information, posing new hypotheses, taking care to meet the standards given in instructions, forming an impression about others based not on stereotypes, but rather on non-stereotypical information, received in "real time". While all of the abovementioned examples referred to the non-specific motivation to reduce uncertainty, we feel that this model could also be fruitfully applied to the cognition motivated by the specific epistemic motivation. Moreover, traditionally researchers focus on identity-relevant cognitions as the best means to achieve certainty. However, there are many accuracy-oriented means that may also serve this goal (see Jonas et al., 2014). For example, for particular groups (e.g. journalists, scientists, etc.) ensuring accuracy may help obtain certainty in an improved manner (van Bavel & Pereira, 2018). The value of accuracy-oriented (i.e. open-minded, extensive, and effortful) strategies as a means of achieving certainty can be accomplished with incentives, and through education systems that cultivate curiosity, accuracy, and accountability. We believe, this eventually could lead to less tribe-like and polarized discussions that many societies experience nowadays.

Finally, we here focused on processing strategies rather than on knowledge per se. However, it is information selection and processing that leads to forming, changing, or maintaining existing beliefs (i.e. knowledge). If one accesses only a limited number of pieces of information, most likely restricted only to those consistent with one's beliefs, there is a weak chance that these beliefs will be revised if incorrect. Furthermore, one's views may further solidify, which will make them more resistant to change in the future. Therefore, it is so crucial to identify conditions which will prevent that from happening.

Note

1 Recent literature uses the terms *motivated cognition or motivated reasoning* in a narrow sense. That is, when one's prior beliefs act to bias information processing so as to make any conclusions congenial to these beliefs. It suggests that *motivated* implies *biased* and precludes *rational* (e.g. Druckman & McGrath, 2019). However, this is also related to the old but ongoing debate on whether biases in reasoning are due to motivation or cognition. We take the position that any cognitive and motivational influences prevail in virtually any epistemic activity. Thus, any cognitive activities are motivated by their very nature (see Kruglanski et al. 2020).

References

Bastardi, A., Uhlmann, E., & Ross, L. (2011). Wishful thinking: Belief, desire, and the motivated evaluation of scientific evidence. *Psychological Sciences*, *22*(6), 731–732.

Baumeister, R., & Newman, L. (1994). Self-regulation of cognitive inference and decision processes. *Personality and Social Psychology Bulletin*, *20*(1), 3–19.

Berkman, E., Hutcherson, C., Livingston, J., Kahn, L., & Inzlicht, M. (2017). Self-control as value-based choice. *Current Directions in Psychological Science*, *26*(5), 422–428.

Berridge, K., Robinson, T., & Aldridge, J. (2009). Dissecting components of reward: 'liking', 'wanting', and learning. *Current Opinion in Pharmacology*, *9*(1), 65–73.

Bolsen, T., Druckman, J., & Cook, F. (2014). The influence of partisan motivated reasoning on public opinion. *Political Behavior*, *36*(2), 235–262.

Burke, B., Martnes, A., & Faucher, E. (2010). Two decades of terror management theory: A meta-analysis of mortality salience research. *Personality and Social Psychology Review*, *14*(2), 155–195.

Colombo, M., Bucher, L., & Inbar, Y. (2016). Explanatory judgment, moral offense and value-free science. *Review of Philosophy Psychology*, *7*(4), 743–763.

Cooper, J., & Fazio, R. H. (1984). A new look at dissonance theory. *Advances in Experimental Social Psychology*, *17*, 229–266.

Ditto, P. H., & Lopez, D. F. (1992). Motivated skepticism: Use of differential decision criteria for preferred and nonpreferred conclusions. *Journal of Personality and Social Psychology*, *63*(4), 568–584.

Dragon, P., & Kossowska, M. (2019). Need for closure and compensatory rule-based perception: The role of information consistency. *European Journal of Social Psychology*, *49*(1), 127–140.

Druckman, J. N., & McGrath, M. C. (2019). The evidence for motivated reasoning in climate change preference formation. *Nature Climate Change*, *9*(2), 111–119.

Easterbrook, J. A. (1959). The effect of emotion on cue utilization and the organization of behavior. *Psychological Review*, *66*(3), 183–201.

Ellemers, N., Spears, R., & Doosje, B. (2002). Self and social identity. *Annual Review of Psychology*, *53*(1), 161–186.

Fernbach, P., Rogers, T., Fox, C., & Sloman, S. (2013). Political extremism is supported by an illusion of understanding. *Psychological Science*, *24*(6), 939–946.

Gendolla, G., Wright, R., & Richter, M. (2019). Advancing issues in motivation intensity research: Updated insights from the cardiovascular system. In R. M. Ryan (Ed.), *Oxford handbook of human motivation* (2nd ed., pp. 373–392). Oxford University Press.

Golman, R., Hagmann, D., & Loewenstein, G. (2017). Information avoidance. *Journal of Economic Literature*, *55*(1), 96–135.

Green, D., Palmquist, B., & Schickler, E. (2002). *Partisan hearts and minds: Political parties and the social identities of voters*. Yale University Press.

Hogg, M., & Abrams, D. (1988). *Social identifications: A social psychology of intergroup relations and group processes*. Routledge.

Jameson, T., Hinson, J., & Whitney, P. (2004). Components of working memory and somatic markers in decision making. *Psychonomic Bulletin & Review*, *11*(3), 515–520.

Jaśko, K., Czernatowicz-Kukuczka, A., Kossowska, M., & Czarna, A. (2015). Individual differences in response to uncertainty and decision making: The role of behavioral inhibition system and need for closure. *Motivation & Emotion*, *39*(4), 541–552.

Jonas, E., McGregor, I., Klackl, J., Agroskin, D., Fritsche, I., Holbrook, C., Nash, K., Proulx, T., & Quirin, M., (2014). Threat and defense: From anxiety to approach. In J. M. Olson & M. P. Zanna (Eds.), *Advances in experimental social psychology* (Vol. 49, pp. 219–286), Academic Press.

Kahan, D. (2017). Misconceptions, misinformation, and the logic of identity-protective cognition. *Cultural Cognition Project Working Paper Series* No. 164; Yale Law School, Public Law Research Paper No. 605; Yale Law & Economics Research.

Klayman, J. (1995). Varieties of confirmation bias. *Psychology of Learning and Motivation*, *32*, 385–418.

Knight, **F. H.** (1921). *Risk, uncertainty, and profit*. Houghton Mifflin Company.

Kossowska, M. (2007). Motivation towards closure and cognitive processes: An individual differences approach. *Personality and Individual Differences*, *43*(8), 2149–2158.

Kossowska, M., & Bar-Tal, Y. (2013). Need for closure and heuristic information processing: The moderating role of the ability to achieve the need for closure. *British Journal of Psychology*, *104*(4), 457–480.

Kossowska, M., Szwed, P., Czernatowicz-Kukuczka, A., Sekerdej, M., & Wyczesany, M. (2017). From threat to relief: Expressing prejudice toward atheists as a self-regulatory strategy protecting the religious orthodox from threat. *Frontiers in Psychology*, *8*, 1–8.

Kossowska, M., Szumowska, E., Dragon, P., Jaśko, K., & Kruglanski, A. W. (2018). Disparate roads to certainty processing strategy choices under need for closure. *European Review of Social Psychology*, *29*(1), 161–211.

Kossowska, M., Szwed, P., & Czarnek, G. (2020). Ideologically motivated perception: The role of political context and active open-mindedness.

Kruglanski, A. W. (1989). The psychology of being "right": The problem of accuracy in social perception and cognition. *Psychological Bulletin*, *106*(3), 395–409.

Kruglanski, A. W., Peri, N., & Zakai, D. (1991). Interactive effects of need for closure and initial confidence on social information seeking. *Social Cognition*, *9*(2), 127–148.

Kruglanski, A. W. (2004). *The psychology of closed mindedness*. Psychology Press.

Kruglanski, A. W., Dechesne, M., Orehek, E., & Pierro, A. (2009). Three decades of lay epistemics: The why, how, and who of knowledge formation. *European Review of Social Psychology*, *20*(1), 146–191.

Kruglanski, A. W., Jasko, K., & Friston, K. (2020). All thinking is 'wishful' thinking. *Trends in Cognitive Sciences*, *24*(6), 413–424.

Kruglanski, A. W., Shah, J. Y., Fishbach, A., Friedman, R., Chun, W. Y., & Sleeth-Keppler, D. (2002). A theory of goal systems. In M. P. Zanna & M. P. Zanna (Eds.), *Advances in experimental social psychology* (Vol. 34, pp. 331–378). Academic Press.

Kunda, Z. (1990). The case for motivated reasoning. *Psychological Bulletin*, *108*(3), 480–498.

Lord, C. G., Ross, L., & Lepper, M. R. (1979). Biased assimilation and attitude polarization: The effects of prior theories on subsequently considered evidence. *Journal of Personality and Social Psychology*, *37*(11), 2098–2109.

Miller, A. G. (1976). Constraint and target effects in the attribution of attitudes. *Journal of Experimental Social Psychology*, *12*(4), 325–339.

Nickerson, R. (1998). Confirmation bias: A ubiquitous phenomenon in many guises. *Review of General Psychology*, *2*(2), 175–220.

Porter, P., & Schumann, K. (2018). Intellectual humility and openness to the opposing view. *Self and Identity*, *17*(2), 139–162.

Proulx, T., Inzlicht, M., & Harmon-Jones, E. (2012). Understanding all inconsistency compensation as a palliative response to violated expectations. *Trends in Cognitive Sciences*, *16*(5), 285–291.

Roets, A., Kruglanski, A. W., Kossowska, M., Pierro, A., & Hong, Y. (2015). The motivated gatekeeper of our minds: New directions in need for closure theory and research. In J. Olson, & M. Zanna, (Eds.), *Advances in experimental social psychology* (Vol. 52, pp. 221–283), Academic Press.

Rothmund, T., Bender, J., Nauroth, P., & Gollwitzer, M. (2015). Public concerns about violent video games are moral concerns—How moral threat can make pacifists susceptible to scientific and political claims against violent video games. *European Journal of Social Psychology*, *45*(6), 769–783.

Schwartz, B. (2004). *The paradox of choice*. HarperCollins.

Suhay, E., Bello-Pardo, E., & Maurer, B. (2018). The polarizing effects of online partisan criticism: Evidence from two experiments. *The International Journal of Press/Politics*, *23*(1), 95–115.

van Bavel, J., & Pereira, A. (2018). The partisan brain: An identity-based model of political belief. *Trends in Cognitive Sciences*, *22*(3), 213–224.

van der Bles, A., van der Linden, S., Freeman, A., Mitchell, J., Galvao, A., Zavala, L., & Spiegelhalter, D. (2019). Communicating uncertainty about facts, numbers and science. *Royal Society Open Science*, *6*(5), 181870.

Washburn, A., & Skitka, L. (2018). Science denial across the political divide: Liberals and conservatives are similarly motivated to deny attitude-inconsistent science. *Social Psychological and Personality Science*, *9*(8), 972–980.