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Opinion

An integrative framework of conflict and control

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People regularly encounter various types of conflict. Here, we ask if, and, if so, how, different types of conflict, from lab-based Stroop conflicts to everyday-life self-control or moral conflicts, are related to one other. We present a framework that assumes that action–goal representations are hierarchically organized, ranging from concrete actions to abstract goals. The framework's key assumption is that conflicts involving more abstract goals (e.g., self-control/moral conflict) are embedded in a more complex action space; thus, to resolve such conflicts, people need to consider more associated goals and actions. We discuss how differences in complexity impact conflict resolution mechanisms and the costs/benefits of resolving conflicts. Altogether, we offer a new way to conceptualize and analyze conflict regulation across different domains.

Highlights

Researchers in psychology and neuroscience want to know whether conflict and control scale up.

Conflict and control mechanisms share many similarities across different levels of analysis. However, empirical evidence does currently not support a unified perspective on action control.

We identify two major challenges for theoretical integration: a vertical challenge that requires conflict at different levels of abstraction to be linked, and a horizontal challenge that requires control of conflict at different points in time to be linked.

We present a new integrative framework in which we propose that the difference between conflicts can best be understood along the dimension of complexity (i.e., amount of information).

We propose that differences in conflict complexity go together with specific costs and benefits and that a normative account of hierarchical conflict control needs to take into account both.

Are all conflicts the same?

Are all **conflicts** (see Glossary), in essence, the same? In the **trolley dilemma**, traditionally used to study moral conflicts, people choose whether to sacrifice one person to save many. In **intertemporal choice** tasks, traditionally used to study self-control conflicts, people decide between smaller immediate and larger delayed rewards. In the **Stroop task**, traditionally used to study cognitive conflicts, people distinguish between relevant and irrelevant information. If these conflicts are entirely different, psychological science would need distinct theories to account for each of them. However, if they are sufficiently similar, capturing them in a single framework could inspire the development of a comprehensive theory of human action.

On one hand, it makes intuitive sense to argue for the similarity of different types of conflict, as they all share the same underlying structure: they involve some form of incongruency that needs to be resolved (Box 1). Also, across various research domains, the process of **conflict resolution** has been conceptualized similarly, as a two-step process (first detecting the conflict, then exerting control [1–3]). On the other hand, the differences between different types of conflict are too glaring to ignore. Some conflicts require people to consider only a few concrete actions (e.g., a single task rule); whereas others require people to consider multiple actions and more abstract goals (e.g., potential consequences, personal preferences). Similarly, some conflicts take milliseconds to resolve, others days or weeks.

Empirically, this controversy is illustrated by findings showing that laboratory-based conflict tasks sometimes do [4] and sometimes do not relate to outcomes of real-life conflict [5–7]. Recent attempts to settle this inconsistency pointed towards problems with methods and measurement [8–12]. In this paper, we argue that the problem runs deeper. We propose that conflict research faces a problem with theory. In support of our argument, we first elaborate on two fundamental differences between conflicts that we believe have posed challenges to theoretical integration so far. Moving forward, we propose a new framework that rests on four propositions that integrate both challenges in a meaningful way. The framework provides a common language allowing researchers

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Box 1. What is conflict? Energy versus entropy

Conflict arises whenever there are incongruent thoughts or action tendencies. But what does conflict mean in mechanistic terms? An intuitive proposal is to express conflict as the proportion of incongruent cognitive processes (thoughts, perceptions, action tendencies) relative to all ongoing cognitive operations [14,91]. However, research suggests that conflict can be parsed into separable components (e.g., response-conflict versus stimulus-conflict) [92]. An influential idea that allows for separate classes of conflict comes from neural network models [1], which propose that neural networks consist of different layers that house, for example, stimulus or response units. Conflict arises whenever multiple units within the same layer are active simultaneously. The degree of conflict, then, is defined as the (scaled) multiplicative product of their activation level, which is known as Hopfield energy [1,93]. The strength and the time course of conflict thus follow directly from the activation of computing units, scaled by the strength of mutual lateral inhibition.

One limitation of conceptualizing conflict in terms of parallel activation of stimulus and response representations with a defined task with known goal-action links (e.g., Stroop) is that it cannot account for abstract representations of upcoming situations or future goals that are more uncertain in nature. So, the conceptualization of conflict as energy needs to be extended to incorporate predictions and their corresponding uncertainty. In computational terms, conflict also entails entropy (i.e., unpredictability) [13], with conflict increasing with the complexity of the situation.

Here we propose to see these two views of conflict as complementary rather than competing. For instance, the concept of conflict-as-energy is relevant to describe the pursuit of currently active goals, while conflict-as-entropy can capture the process of choosing a future goal among multiple alternatives.

across domains in psychology and neuroscience to relate different kinds of conflict to each other. Beyond its potential to explain existing research within a shared perspective, the framework generates new predictions and sets an agenda for future research on conflict regulation.

The vertical challenge: what conflicts are made of

Conflict is a central motif in psychology and has always spurred crosstalk between different disciplines. For example, early ideas from information theory (about conflict in the context of curiosity [13]) motivated cognitive dissonance theory in social psychology [14] and inspired computational models in cognitive neuroscience [1]. Exchange is also common on the methodological level: originally developed as a cognitive paradigm to assess attentional filtering, the Stroop task has been applied in research programs to study conflicts in self-control [7,15,16], psychopathology [17], stereotyping [18], social power [19], romantic relationships [20], and personality [21]. Recently, researchers have realized that theories and paradigms need to be integrated more thoroughly, asking whether some cognitive or neural mechanism is common to all conflicts [22,23]. For example, it has been proposed that all conflicts are tied to negative affect [24–30], or involve expectancy violations [31]. From that, there seems to be an emerging consensus that all conflicts are similar enough to be captured by a single model.

Despite this consensus, conflicts differ widely in terms of the nature and scope of their components. Some conflicts (e.g., resolving a Stroop trial) require people to consider just one concrete action rule, whereas other conflicts (e.g., deciding to quit one's job to travel the world) require people to simultaneously consider a greater number and often more abstract aspects of goals (e.g., current needs, potential consequences, relative value of the options). Yet, how these conflicts can be mapped to each other is still poorly understood across literatures. We term this problem the vertical challenge and we use this term to describe the difficulty of relating conflicts across different levels of a hierarchy.

The horizontal challenge: when are conflicts resolved

In trying to understand how people resolve conflicts, most theories propose some variant of a two-step process, in which conflict is first detected and then resolved [1–3,25,32,33]. For example, cognitive neuroscience accounts [1] describe a monitoring mechanism that triggers conflict resolution by biasing attention toward task-relevant features. In line with this model, imaging

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studies show dissociable neural activity in the anterior cingulate cortex (occurring when conflict is detected) versus the dorsolateral prefrontal cortex (occurring when task-relevant attention is boosted [34,35]). Such a two-step process is also inherent to cybernetic models of self-regulation, which assume a monitoring system that compares desired and actual goal states, and an implementing system aiming to reduce potential discrepancies [32]. Similar two-step models explain conflict resolution in various other domains, like self-control [2,36], emotion regulation [37], moral decision making [38], and knowledge acquisition [39].

Yet, despite these commonalities, there are glaring differences between domains in the temporal extension of conflict resolution. To illustrate, we compare a conflict in the Stroop task with a conflict between two food options, say, between eating salad or pizza for dinner. Conflict in the Stroop task is resolved by attending to task-relevant stimulus features. However, when deciding between food options, people use qualitatively different and temporally more protracted strategies. For instance, the process model of self-control [40] assumes that conflict regulation can be subdivided into different stages, with attention deployment being only one way to regulate conflict. Other ways, like changing the situation (e.g., avoiding the pizza restaurant), can prevent conflict from occurring in the first place. And, when it is too late to avoid the conflict, people can still reappraise the situation (e.g., 'I deserve the pizza'). Importantly, these strategies can come into play at different points in time for different conflicts. We refer to this as the horizontal challenge, which pertains to the difficulty of relating conflicts across the temporal space in which control is recruited.

Proposing an integrative framework of conflict and control

It is difficult to overstate the relevance of both challenges for conflict researchers. This becomes apparent when we consider the correlational approach, the most-used research strategy to assess how conflict and control are related across domains. In this approach, researchers test the same participants in different conflict tasks. If, for example, conflict resolution in the Stroop task co-varies with people's efficacy to resolve self-control or moral conflicts in the lab, or even in real life, this would indicate that a direct mapping of conflict and control across domains is feasible [41,42]. However, findings obtained with this approach have been mixed, with many studies reporting no or only very weak associations [5–7,43].

We argue that the problem conflict researchers are facing is a more fundamental one. If we want to better understand how conflict and control can be linked across domains, we must explain the variability people show in their attempts to control conflict on multiple levels and across time. We present an integrative framework that captures the challenges portrayed earlier. It outlines four basic propositions that describe conflict and conflict resolution through a hierarchical organization of action–goal representations. By doing so, it suggests that the vertical and horizontal challenges are not independent, but that one follows from the other. The framework has implications for our understanding of conflict regulation and allows researchers to draw meaningful links between different levels of analysis and research traditions.

Proposition 1. Action and goal representations are hierarchically organized

We draw from models of action control that posit that **action-goal representations** are hierarchically organized; more abstract action representations (or goal representations) activate increasingly concrete action representations, and ultimately, actions [44–46]. Our framework captures this assumption in the hierarchical organization of nodes representing concrete actions at the lowest level ('press button A' or 'order the pizza'), and abstract goals at higher levels ('follow instructions' or 'enjoy oneself'; Figure 1A). Representations become increasingly more abstract higher up in the hierarchy ('enjoy oneself' is more abstract than 'get tasty food'). Notably, conflicts

Glossary

Action-goal representations: a hypothetical construct within cognitive processing that represents personal goals, values, and the like (i.e., higher-level goal representations) as well as the perception of the end state or result of a concrete (motor) action (i.e., low-level action representation). Goal and action representations are interlinked in a larger associative network, which is often depicted in the form of nodes (goal/action representations) and lines (associations).

Complexity: the number of connections within the network (e.g., during planning, simulation, evaluation, consideration, and adjustment of possible action plans and their consequences). In the goal hierarchy, more abstract goal representations are embedded in a broader action space, because of the larger number of links between goals and subgoals, means, and actions (cf. goal hierarchy).

Conflict: occurs when two or more mutually incompatible goal and/or action representations are active at any level or between levels of the goal hierarchy.

Conflict resolution: processes involved in implementing actions, changing goal representations, and/or revising the goal hierarchy to end the conflict experience. Conflict resolution can be fast but can also protract over time.

Goal hierarchy: the relationship of different goal and action representations in a spatial arrangement, with more abstract goal representations higher up in the hierarchy and concrete action representations at the bottom. Moving up the hierarchy (i.e., increasing abstractness) means that goal representations entail an increasing number of subgoal and action representations (i.e., cover more action space), implying a greater number of possibilities for intervention (cf. complexity).

Intertemporal choice: a classic self-control conflict between a smaller, immediately available reward and a larger, delayed reward, where the subjective value of the later reward is devalued because it is further in the future.

Stroop task: a classic experimental paradigm used to study cognitive conflict. Participants are asked to name the ink color of a color word while

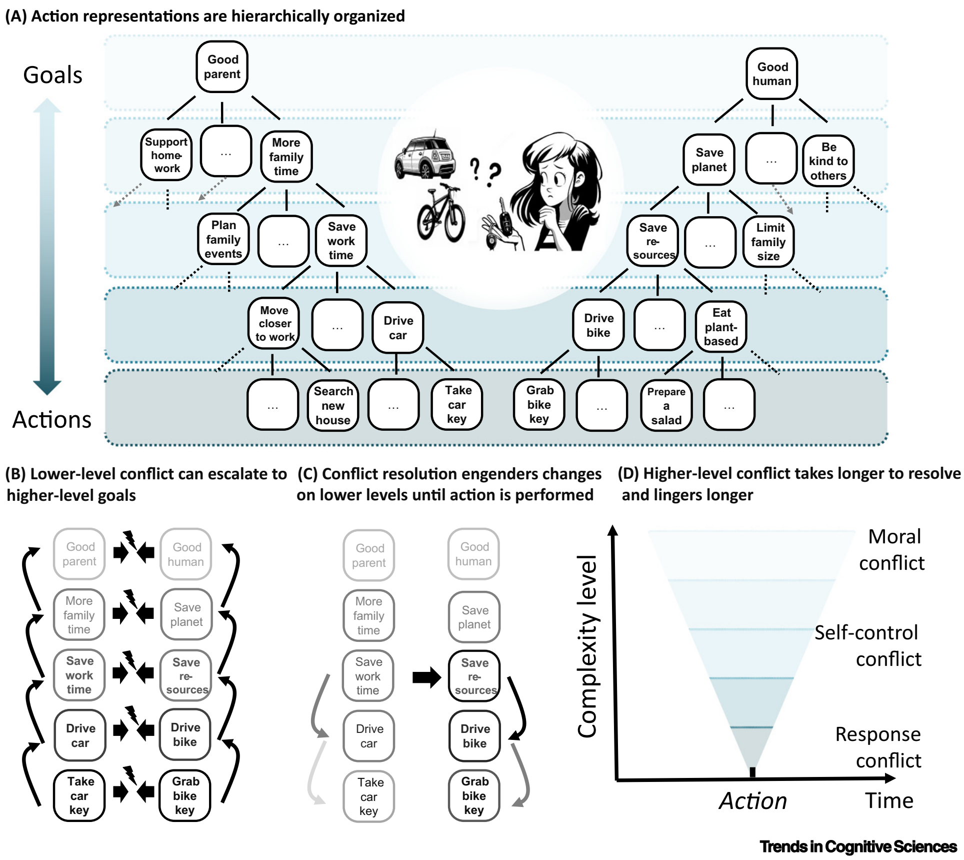

Figure 1. Schematic representations of the integrative framework of conflict regulation. (A) The hierarchical organization of action/goal representations, with concrete action representations (darker shade of grey) at the bottom layer and increasingly abstract goal representations towards the top layer (lighter shades of grey). Boxes depict nodes, which represent specific actions or goals. Paths depict bi-directional activations between nodes. (B) Lower-level action conflicts can trigger higher-level goal conflicts. (C) When the conflict is resolved by changing the representational strengths of a higher-level goal representation (e.g., commit to saving natural resources), this will engender changes on lower levels until an action is performed (e.g., grab bike key). (D) Both challenges are not independent: conflicts of higher complexity (represented at higher levels of abstraction) do not only occupy a larger action space, but they also occupy a more prolonged temporal space and more diverse resolution strategies. Time on the horizontal axis represents the duration (i.e., temporal space) of conflict regulation.

can occur on every level of the action–**goal hierarchy**, both between representations at the same level and between representations at different levels.

Proposition 2. Action representations are at the heart of all conflicts

Assuming that all (even abstract) representations are grounded in actions [45,47], we propose that conflict and conflict resolution are ultimately action-oriented. In our framework, this implies a bi-directional flow of information. This means that: (i) lower-level conflict can escalate to higher-level goals (e.g., besides executing the task rule, resolving a response conflict in the Stroop task may also involve the abstract goal to perform well or to earn money; Figure 1B); (ii) conflicts between higher-level goals always imply conflicts at the action level, either real or hypothetical (e.g., pulling versus not pulling the lever in a trolley dilemma); and (iii) conflict resolution engenders changes on lower levels until the action is performed (Figure 1C). Importantly, this means that a seemingly identical action conflict (e.g., whether to grab the car or bike keys;

ignoring the meaning of the word. Word color and meaning can either match or mismatch. In the latter case, participants experience conflict between the instructed response goal (name the ink color) and the response tendency triggered by automatic word reading.

Trolley dilemma: a classic moral dilemma about whether or not to sacrifice one person to save many, used to study moral conflicts. It describes the scenario of a runaway train about to kill several people on the tracks. Participants are asked to identify with a bystander who can divert the train to another track but would thereby kill another person. In contrast to (norm-oriented) deontology, (outcome-oriented) utilitarianism regards the sacrifice as required.

Figure 2, Panel B) can be represented at different levels of abstraction (e.g., saving time versus saving resources or being a good parent versus a good person).

Proposition 3. More abstract goals are embedded in a more complex action space

The more abstract the goal representation, the further away it is from a specific action [44,45]. This is in part because abstract representations contain the gist of things rather than details [48], but also because there are simply more means available to achieve an abstract goal (e.g., to 'pursue good health', one could eat healthy food, exercise more, or try to sleep better). Abstract goals thus entail a larger number of links between goals, subgoals, means, and actions. Resolving conflicts at the level of more abstract goals, therefore, implies a larger number of possible subgoals and actions being activated. Thus, abstract and concrete representations entail different levels of **complexity**. To define complexity, we take inspiration from information-theoretic approaches that understand complexity in terms of the amount of information required to describe the conflict (i.e., description length [13], see also 'policy complexity' [49,50]). In the proposed framework, the amount of information depends on the number of connections between different nodes within the network (i.e., superordinate goals, goals, and actions; see Proposition 2). Thus, the amount of information in the hierarchical structure of our framework approximates complexity

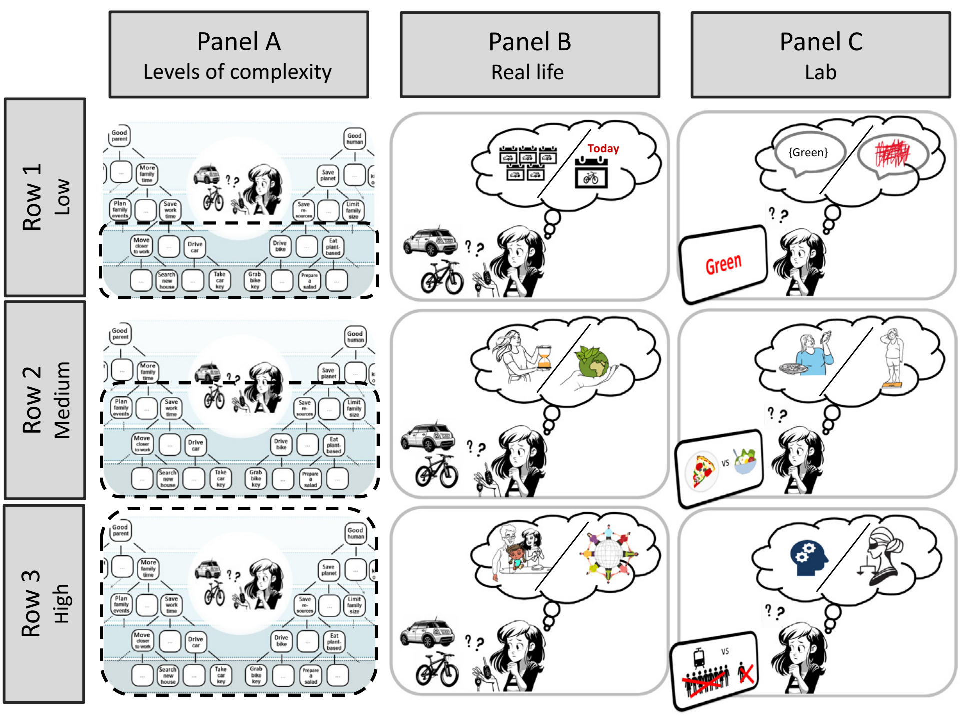

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Figure 2. Conflicts at different levels of complexity. Examples of different kinds of conflicts at low (Row 1), medium (Row 2), and high (Row 3) levels of complexity. Conflict resolution for more complex conflicts requires moving up the hierarchy and thus covers more action space. Panel A shows the level of complexity (see Figure 1A). The more complex the conflict gets, the more nodes (e.g., goals and actions) it includes. Panel B depicts the same real-life conflict (grounded in the action to grab the car or bike keys) on three different levels of complexity (from top to bottom: habitually grabbing the car key versus grabbing the bike key today as planned; saving time versus saving resources; being a good parent versus being a good person). Panel C depicts different lab-based conflict tasks at the corresponding level of complexity (from top to bottom: habitual word reading versus instructed color naming in the Stroop task; health versus indulgence goal in a self-control task; deontological versus utilitarian orientation in the trolley dilemma).

and can be used to scale goals and actions in a meaningful way. Accordingly, conflicts higher up the hierarchy take more space in the diagram as they include more associated subgoals and actions than conflicts at lower levels (Figure 2, Panel A).

Proposition 4. Conflict between increasingly abstract goals extends over time

Let us revisit some typical examples of conflict (Figure 2, Panel C). In the Stroop task, conflict arises between concrete actions (response triggered by automatic word reading and response rule). In line with our framework, this low-level conflict comes with a rather narrow time scale, with a focus on conflict resolution within a single trial or shortly before or after the trial [51]. In a self-control conflict task, conflict arises between, for example, the goal to stay healthy and the desire to eat pizza. In a moral conflict, deontological and utilitarian principles compete. To describe each of these conflicts, we need to move up the goal hierarchy. Because conflicts higher in the hierarchy are more complex (e.g., due to a higher number of considerations and associated actions), there are more possibilities to intervene, and people have a broader repertoire of control strategies at their disposal. For instance, a person might anticipate a possible conflict and avoid exposure to tempting stimuli. Alternatively, a person might re-evaluate experienced conflict differently by appraising a situation as a possibility to indulge. Thus, conflicts at high levels of abstraction do not only occupy a larger action space (see Proposition 3), but they also occupy a more prolonged temporal space during which different forms of control can be employed (see funnel shape in Figure 1D).

Implications

Our framework proposes that differences between conflicts can best be understood along the dimension of complexity. It suggests that the vertical and horizontal challenges are closely related: because more complex conflicts are embedded in a larger action space, they allow for more diverse control strategies, and thus, conflict resolution extends longer in time. Our conceptualization has key implications for models of conflict resolution. We next discuss how differences in complexity affect mechanisms by which people resolve conflict, how conflict resolution mandates a trade-off between costs and benefits, and we propose an agenda for future research.

Hierarchy determines conflict resolution

Self-control researchers are debating what mechanisms underlie conflict resolution [52–54]. Some researchers argue that control reflects the inhibition of automatic response tendencies [52]; others argue that self-control can best be understood as a dynamic decision-making process in which different options are weighed [53]. Our framework has the potential to resolve this debate, by suggesting that the two perspectives describe conflict resolution at different levels of abstraction. This idea is consistent with existing accounts of a hierarchical organization of control processes in the frontal cortex [55]. At lower levels of abstraction, control requires people to consider fewer and more concrete goals and actions (Proposition 3). Hence, the resolution of simple conflicts, as investigated with the Stroop task, can be described as the inhibition of an inappropriate action (e.g., 'to grab the car keys' needs to be inhibited when people had planned 'to take the bike'; Figure 2, Panel B, Row 1). Here, control ensures the correct response within the context of a specific rule. By contrast, conflict regulation at higher levels of abstraction resembles a multi-stage decision-making process (e.g., people oscillate between 'to save time' and 'to save natural resources'; Figure 2, Panel B, Row 2), which requires people to simulate and evaluate various actions and their potential consequences [56–59]. In such situations, a variety of control processes can take place (e.g., attention deployment, appraisal [60]). Here, control serves to ensure conflict resolution, *per se*, namely, resolving the conflict rather than deferring the decision. In this way, our framework offers a big-picture perspective on the contrasting ways in which self-control is currently being conceptualized (Box 2).

Box 2. Reconciling current debates on conflict and control

Dual- versus single-process

Traditionally, control has been type-cast as the antagonist to automatic and impulsive tendencies. Dual-process models capture this idea by construing control as a slow and deliberate process that inhibits fast and automatic impulses. This view has been challenged by single-process models which describe control as a value-based choice that weighs actions according to their costs and the benefits of potential outcomes [53]. Recently, similar debates in various domains (e.g., self-control) have focused on differences in assumed mechanisms. Our framework can reconcile this debate by showing that the two perspectives describe conflict resolution at different levels of complexity (Proposition 3).

Unitary versus fractioned control

Our framework also contributes to a debate asking whether control is due to a single controller (i.e., the unitary hypothesis) or is the consequence of multiple, independent controllers. For example, personality research asks whether different conflict tasks can be explained by a few latent variables [94]. Neuroscientists debate whether prefrontal areas reflect a core network for control or local individual controllers [95]. Cognitive science discusses whether control processes can generalize across tasks or be task-specific [96]; and developmental science tests whether training control transfers to other tasks or not [97]. Here, we propose that while basic aspects of conflict processing are shared across tasks, the fractioning depends on the complexity (with more abstract conflicts allowing for broader control strategies, Proposition 4) and the specifics of how actions are implemented (Proposition 2). Our framework also suggests when research should expect to find evidence for the unitary view (e.g., when measures are aligned along the horizontal axis) and when to expect evidence for the fractioned view (e.g., when measures do not align).

Weakness of will versus goal inconsistency

Finally, self-control failures have often been conceptualized as a weakness of the will in which impulses overrule intended behavior. An alternative conception considers conflicts as a (temporal) inconsistency of different goals [98]. From this perspective, a failure of control reflects a change in the importance of goals, either because a temporally more distant goal is discounted or because a goal that promises immediate reward (i.e., hedonic goal) becomes self-relevant (e.g., sharing pizza because you celebrate a special occasion with friends [99,100]). Our framework captures both perspectives. Conflict between more abstract goals provides a description of goal-inconsistency (Proposition 3), whereas conflict at concrete levels refer to situations in which specific action impulses overrule goals or intentions.

The empirical finding that correlations between different conflict measures are often low was previously considered surprising in the literature. Our framework, however, suggests that these correlations should be expected to be low because, at different levels of complexity, conflict measures tap into different action representations, which require different forms of conflict resolution. Relatedly, because more complex conflicts extend longer in time, they allow for more diverse control strategies (Proposition 4). Thus, it is unrealistic to expect that the way people resolve low-complexity conflicts is directly related to how people resolve high-complexity conflicts. Our framework could guide future work that aims to optimize the correlational approach. It may be possible to accurately predict how people resolve real-life conflicts from lab-based tasks if measures are more aligned on action abstraction and strategy selection [40,51].

The costs of going up the hierarchy

Our framework also provides an explanation for why people often fail to consider their higher-level goals [61]. According to Proposition 3, moving up the goal hierarchy implies representing (and simulating) an increasing number of actions and their consequences. Given the embodied nature of action planning and action simulations (Proposition 2), these processes require time and cognitive resources [62]. That is, not only do more abstract goal representations come with more connections to other nodes in the network, but the neural representations that are involved are also more likely to overlap with neural representations related to competing goals, increasing the likelihood of interference [63,64]. Moreover, resolving conflicts at a higher level of abstraction will be accompanied by a stronger sense of uncertainty. Since abstract conflicts involve the consideration and evaluation of an increasing amount of information (Proposition 3), uncertainty increases about which action is the 'correct' one (e.g., 'Is it more important to spend time with my family or to save natural resources?'), and uncertainty about whether a specific action leads to the desired outcome (e.g., 'Does taking the bike really help save the planet?'). For both reasons (increased representational overlap and uncertainty), conflict resolution at higher levels should generally be more costly. As a consequence, we predict that all else being equal, people should have a general preference to resolve conflicts at lower levels of the action–goal hierarchy [44] and to avoid higher-level conflict resolution [62].

A further benefit of resolving conflict at lower, rather than higher, levels of abstraction it is that this may support behavioral consistency (i.e., enacting the same behavior in the same or similar contexts in the future). There has been much interest in the effect of conflict resolution on future behavior across domains (e.g., congruency sequence effect, sustained self-control behavior). One common assumption is that conflict functions as a learning signal reinforcing active representations [3,65]. Without acknowledging the hierarchical organization of action–goal representations, however, any model assuming the common two-step control process will come to the similar conclusion that conflict will reinforce whatever representation drove the action (e.g., task rule, health goal, moral value), with more consistent future behavior as a result. Our framework, however, suggests that complexity matters. Specifically, it predicts that conflict complexity should modulate learning. Given that conflicts higher up the hierarchy include more associated subgoals and actions (Proposition 3), we expect that the reinforcement signal should spread across multiple nodes rather than just one. In line with goal system theory, and general spreading activation accounts, which posit that the strength of the activation decays as it propagates through the network [46,64] we propose that the link between the enacted behavior and the reinforced goal should be relatively weaker the more abstract the goal is (and stronger for more concrete action plans or goals). As a consequence, high-level conflicts should be followed by relatively lower behavioral consistency [66]. This effect may be compounded by the fact that single actions rarely immediately satisfy abstract goals, which means that the learning signal is delayed and thus weaker to begin with [67].

By contrast, when conflicts are solved at a low level, a concrete task rule is enacted and reinforced, which should readily strengthen behavioral consistency. This prediction resonates with research showing that behavioral interventions that require the implementation or monitoring of concrete actions are often effective (e.g., in the context of health behavior [68]; in the context of psychotherapy [69]). Possibly, these interventions reduce complexity by limiting possible connections between goals and actions (Proposition 3). In turn, this may reduce opportunity costs, uncertainty, and regret [29,70]. An important question for future research is how to increase certainty and confidence about resolving abstract conflicts, as this might be a way to nonetheless achieve behavioral consistency. Prior work suggests that giving more weight to the action-congruent, but not the action-incongruent, goal can boost confidence (e.g., 'to save resources' and not 'to save time' in case one chooses to take the bike [71]). Our framework adds that this intervention should be especially useful in the context of abstract conflicts, where confidence is potentially lower. Perhaps, this can be achieved by explicitly guiding people's attention to the action-congruent goal or providing positive feedback.

The benefits of going up the hierarchy

If resolving conflict on the level of abstract goals comes with costs, why should people escalate to this level at all? Our framework predicts that higher-level conflict resolution has the potential to influence behavior across contexts and in the long term. First, we note that even small amounts of activation can strengthen a goal when repeated over time. For example, a person's health goals will never get reinforced if they always solve food conflicts at a low level ('I eat salad today because it is salad day'). Yet, their health goal will get reinforced, at least sometimes, if they sometimes resolve food conflicts at a high level ('I eat salad today because I find a healthy lifestyle important').

Given people's general tendency to solve conflicts at lower levels, our framework explains why people find it difficult to act in line with their goals in new situations. Second, as abstract goals are mapped onto more subgoals, our framework predicts that there should also be more generalization across behaviors that serve the same goal when conflicts are resolved at a higher level (e.g., repeatedly choosing the bike for environmental reasons should increase the likelihood of buying a vegetarian meal). Such generalizability is particularly useful for the pursuit of more abstract goals, as these can only be achieved through repeatedly engaging in a variety of goal-conducive actions.

A final benefit from resolving conflict at higher levels stems from the observation that abstract goals are often core goals (i.e., goals that are intertwined with people's identity) [44,72]. Thus, resolving conflicts at higher levels of abstraction may be important for people's self-concept and for experiencing actions as meaningful [73]. That is, we predict that, over time, resolving conflicts at a higher level may produce a broad and diverse, yet identity-congruent behavioral pattern [74]. The enhanced impact over time with increasing levels of complexity is captured in the funnel shape in Figure 1D. In sum, drawing from our framework, we posit that resolving conflict at higher levels has costs (e.g., increasing computational costs and uncertainty), but also unique benefits (e.g., generalization and identity shaping).

Research agenda

Computational models of control and decision-making suggest that behavior follows from a cost–benefit trade-off, in which people weigh anticipated costs against potential rewards [75]. Although these models can successfully describe behavior, it often remains unclear *why* control of some conflicts is more costly than the control of others. Our framework provides a potential answer to this question: we propose that complexity, represented as the amount of information or number of possible connections in the network, should scale with processing costs of going up the hierarchy (i.e., increasing abstractness of the active representations; Proposition 3). This form of meta-control [76,77] can, therefore, be conceptualized as a decision about the level of abstraction (and thus complexity) at which conflicts are resolved. Based on this novel perspective, future computational work could arrive at an account of hierarchical conflict control, by juxtaposing the costs and benefits of complexity.

More broadly, our framework can serve as a starting point for an interdisciplinary, systematic, experimental approach to studying conflict regulation in different domains. Concretely, our framework suggests that we need new experimental paradigms, which allow the manipulation and measurement of conflicts of varying complexity. A first step is to examine how conflict complexity can be captured in reaction times [78], different types of errors [79], and behavioral and (neuro) physiological indicators [80–82]. For example, more complex conflict stimuli should produce longer reaction times than stimuli of lower complexity in the same task [83]. Relatedly, since more, compared to less, complex conflict resolution may involve the use of different strategies, it is necessary to attempt to assess multiple control strategies within the same task [84]. One could also investigate variation in subjective conflict complexity by assessing its determinants (e.g., number of considered goals or actions) or its consequences (e.g., amount of strategies used, uncertainty about correct response, outcome uncertainty, experience of effort) via self-report [85,86].

A second step is to manipulate the complexity of conflicts [62,78]. For example, a recent study manipulated 'policy abstraction' in a cognitive control task by varying the number of contextual contingencies of the task rule (one symbol determines response versus two or more symbols jointly determine response [62]). In line with our framework, they show that participants avoided higher policy abstraction tasks more often. Building on those initial efforts, future research requires experimental paradigms that allow a systematic and equivalent mapping of complexity across different research traditions. We, therefore, recommend building hybrid paradigms that allow for different types of conflict (e.g., typical response, self-control, and moral conflicts) within the same task or design space [87]. For example, one could think of designing a task in which an agent has to make consecutive decisions that vary in conflict complexity: delivering packages across the city and encountering low complexity conflicts (e.g., following instructions of traffic agent versus traffic lights) and high complexity conflicts (e.g., picking mode of transportation: environmentally friendly bike versus more efficient car).

Finally, it is necessary to combine both measurement and manipulation of conflict and complexity because conflict representations vary depending on person and situation. For example, contextual factors such as fatigue may reduce people's willingness to invest the higher costs of moving up the hierarchy [88]. Similarly, individual differences, such as trait self-control, may impact at what level people represent the conflict and their choice of conflict resolution strategies [60,89,90].

Concluding remarks

For decades, researchers have been concerned with the question of whether 'all conflicts are the same'. Here, we present an integrative framework that proposes that different conflicts vary along the dimension of complexity. The framework captures the similarities and differences between different conflicts and provides a unifying language and conceptual frame that allows researchers across domains to relate different kinds of conflict to each other. Although many open questions remain (see Outstanding questions), the framework explains existing phenomena and disparities in the literature and offers novel insights and predictions, yielding a new agenda for research on conflict regulation across different domains.

Outstanding questions

How are hierarchical action representations learned and implemented? Which computational frameworks (e.g., hierarchical reinforcement learning) could capture the underlying mechanisms?

How do motivational and emotional processes influence conflict resolution across hierarchies? Is motivation required to solve conflicts at higher levels of the hierarchy? Do emotions influence the speed with which information is propagated through the levels of hierarchy?

We currently refer to complexity as the number of connections between nodes in the network (policy complexity). A complimentary description of complexity could include the efficiency with which these connections become activated (computational complexity). Extending the definition of complexity within our framework could help explain phenomena like habit formation.

Since the framework is broadly consistent with existing accounts of a hierarchical organization of control processes in the frontal cortex, can we leverage recent neuroimaging techniques (e.g., representational similarity analysis) to assess complexity in conflict processing across different domains and tasks?

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Declaration of interests

No interests are declared.

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