

# A framework for interpreting the relationship between risk-taking and self-control in adolescence

Thiago F. A. França<sup>1</sup> and Sabine Pompeia<sup>1</sup>✉

<sup>1</sup>Universidade Federal de São Paulo. Escola Paulista de Medicina. Departamento de Psicobiologia. São Paulo-SP, Brazil

Adolescence is often described as a phase marked by elevated risk-taking. Commonly held theories claim that these behaviors are caused by a developmental mismatch between reward-processing and cognitive control systems, as the later seems to fully mature only in early adulthood, making adolescents prone to self-control failures in the face of potential rewards. However, adolescents – much like adults – may engage in risky behaviors not only because of failures in self-control but also because of conscious and deliberate (even if objectively poor) decisions. In practice, it is not easy to distinguish between these two scenarios because when people fail in self-control they actually do things they *want* to do. In the case of adolescents, the problem is further complicated because we tend to judge their behaviors as failures of self-control based on adult standards about risky behavior. In this essay, we build on the philosopher Harry Frankfurt's classical work on free will to provide a framework for determining when and why a given risky behavior stems from a failure of self-control. This framework enables the proposal of a set of clear and reasonable criteria that can be used in future research to clarify the relationship between adolescent risk-taking and self-control.

Self-control | Self-regulation | Risk-taking | Risky behaviors | Adolescence  
Correspondence: [spompeia@unifesp.br](mailto:spompeia@unifesp.br)

## Introduction

Adolescence is believed to be a phase of life marked by increased risk-taking, to the extent that many authors suggest that these behaviors peak at this age compared to childhood and adulthood (Steinberg, 2007; Steinberg, 2008; Steinberg et al., 2008; Shulman et al., 2016). The usual explanation for adolescents' propensity for risky behaviors is based on dual-systems models. While there are some variations in these models, the main idea revolves around the existence of a developmental mismatch between the cognitive mechanisms involved in reward processing and cognitive control (Steinberg, 2007; Steinberg, 2008; Steinberg et al., 2008; Galván, 2010; Casey, 2015; Casey et al., 2016; Shulman et al., 2016; Icenogle and Cauffman, 2021). According to these models, the mismatch is underpinned by differences in the timing and the rate of maturation of different brain regions involved with each of these processes, namely, a set of early-maturing subcortical regions in the case of reward processing, and later-maturing frontal cortical regions in the case of cognitive control (Steinberg, 2007; Steinberg, 2008; Steinberg et al., 2008; Galván, 2010; Casey, 2015; Casey et al., 2016; Shulman et al., 2016; Icenogle and Cauffman, 2021).

In psychological terms, the dual systems accounts of the engagement of adolescents in risky behaviors can be summarized as resulting from two elements. The first element is that

adolescents display increased sensation seeking and reward sensitivity when compared to children and adults, which renders them more motivated to engage in risky behaviors. Of note, implicit in this argument is the assumption of adolescents having a taste for, or curiosity about, the behaviors in question – in other words, adolescents must find these risky behaviors rewarding, otherwise reward sensitivity/sensation seeking would not lead to engaging such behaviors. The second element is that adolescents exhibit an immature capacity for self-control – the capacity to exert top-down control on motivational conflicts, impulses, and urges (for more discussion about this concept, see Box 1). So while adolescents score high in sensation seeking, they lack the self-control aptitude of adults (Steinberg et al., 2008; Shulman et al., 2016; Steinberg et al., 2018). Under the dual-system frameworks, the combination, or imbalance, of all these elements leads to the view that adolescent risk-taking is usually the result of failures in self-control (Steinberg, 2007; Steinberg, 2008; Steinberg et al., 2008; Shulman et al., 2016).<sup>1</sup>

The idea of adolescence as a time of peak risk-taking is lent credibility not only by this seeming propensity for self-control failures, but also by additional factors that can increase the incidence of such behaviors. On top of the factors discussed above, there are additional elements that contribute to adolescents' risk-taking behaviors, such as increasing unsupervised time compared to childhood, and the possibility of having experiences that weren't previously available (such as higher access to alcohol) coupled with the reduced life experience of this age (Defoe et al., 2015; Romer et al., 2017).

Taken together, the dual systems view, along with the above-mentioned contextual/life history factors across adolescence, seem to provide a neat account of adolescents' propensity for reckless and risk-taking behavior as a perfect storm for self-control failures. Unfortunately, as with so many simple and compelling narratives, this one starts to show gaps under closer inspection.

## Risky behaviors across development

The first issue with the dual-systems accounts of adolescent risk-taking is in the characterization of the patterns of adoles-

<sup>1</sup>Of note, there is an alternative to dual-systems models called the triadic model (Ernst, 2014; Ernst et al., 2006). This model postulates a third element to the explanation above – an emotion-related neural system involved in aversive behaviors and dependent on the amygdala, hippocampus, and insula. While the triadic model does not solve the main issues discussed in this essay, it does provide a more nuanced discussion of adolescent risky behaviors by considering the role of risk aversion in decision-making. However, for reasons we do not understand, the triadic model has not been nearly as influential as the dual-systems models in the scientific discourse on adolescent risk-taking.

cent behavior, which are the very phenomenon these theories claim to explain. It is common to assume that risky behaviors peak during adolescence, but is this really true? Recent research suggests this is not the case. Contrary to conventional wisdom, some of the most commonly studied risky behaviors, such as drinking, smoking, having unprotected sex, or getting in the car with a drunk driver, do not actually peak during adolescence in most cultures studied – they peak years later, and even increase throughout the third decade of life (Duell et al., 2018; Peeters et al., 2019; Willoughby et al., 2021). There are also data suggesting that, at least in some populations, most adolescents do not really engage in these risky behaviors (Peeters et al., 2019).

Of course, adolescents are not zealous risk-averse sages either. This period of life does seem to be marked by elevated sensation-seeking and impulsivity compared to adults (Steinberg et al., 2008; Steinberg et al., 2018), and adolescents often do make non-deliberate decisions (Maslowsky et al., 2019). Furthermore, prior life experience seems to play a role in making better decisions under risky circumstances. As experience accumulates and memory schemas are formed, people can create mental shortcuts requiring less cognitive effort to make appropriate decisions, something that may be particularly important when facing multiple uncertain outcomes, especially in emotionally charged situations (for more on the theories behind this argument, see Dafoe et al., 2015; Romer et al., 2017). Due to their limited life experience, adolescents are at a disadvantage in this respect compared to adults and thus must use more cognitive effort to decide what to do (see Dafoe et al., 2015; Romer et al., 2017). When we combine these factors with the increase in unsupervised time and the opening of new opportunities for many types of risk-taking, we do have a recipe for risky behaviors.

Another aspect that should be taken into account here, despite being largely ignored in the literature, is that the type of risk matters. While there seems to be a monotonic improvement across development regarding decision-making when people are aware of risk probabilities, there is considerable evidence that adolescents are more tolerant to ambiguous or uncertain risks compared to adults and children (Tymula et al., 2012; Romer et al., 2017). All that said, an account for risky behaviors motivated by inexperience and by a tolerance to ambiguous risks should look very different from an explanation for risky behaviors motivated by high reward-sensitivity combined with poor cognitive control.

### ***Risk-taking versus risky behavior***

A second issue with the standard account of adolescent risk-taking is the often-ignored distinction between risk-taking and risky behaviors (Jessor, 2018). The term “risk-taking” implies that an individual took a risk. That is, the individual knew the risk, and engaged in the behavior in spite of the risk, or even because of the risk. After all, one cannot “take” a risk that one does not acknowledge actually exists. But whether or not one understands the risks associated with a given (objectively risky) behavior, engaging in it will still be a “risky behavior”. So while “risk-taking” is the term

most commonly used to refer to adolescent behaviors such as drinking, smoking, or having unsafe sex, these are not necessarily risk-taking behaviors. This is so because adolescents may not have an appropriate understanding of the risks involved in such activities, or may think themselves immune to such risks. In fact, there is evidence that adolescences are indeed less mature in their perception of risks associated with commonly studied risky behaviors (Steinberg et al., 2009), and that the perceived severity of the risks associated with a given behavior correlates negatively with the practice of that behavior (Benthin et al., 1993). The distinction between risk-taking and risky behaviors is important because behaviors can only be considered failures of self-control if they are also risk-taking behaviors. Stated differently, if one does not see any reason to avoid a certain behavior, then engaging in it cannot possibly be a failure of self-control (even if the behavior involves risks or objectively bad decisions).

### ***To do or not to do***

Things can get even muddier when we take into account the reasons why adolescents do what they do. Studies asking adolescents why they engage in risky behaviors reveal a variety of motives, from simple enjoyment or having fun, to the desire to conform with peer expectations or to “be cool/tough” (Defoe et al. 2022). This should make us question whether such motivated behaviors can really all be labeled as self-control failures. That said, just because adolescents can provide reasons for their behavior does not exclude the possibility of self-control failures – such reasons could merely reveal the temptations that led them to fail in self-control.

However, it often seems the case that adolescents actively use their cognitive abilities, even self-control, to create opportunities for engaging in risky behaviors. Consider the case of an adolescent who consumes alcohol. In most countries, alcohol is not easily available to teenagers, so creating the very opportunity to engage in drinking usually requires some degree of effort and planning supposedly lacking in individuals with low self-control. Similar reasoning can be applied to the cases of having sex, taking drugs, and other commonly studied risky behaviors. It is not obvious how effortful behaviors such as these could reflect a failure of self-control. This leads to our main question in this essay, namely: How can we distinguish a failure of self-control that leads to risk-taking from a conscious, deliberate decision to do something that can lead to risks?

Although adolescents may indulge in risky or risk-taking behaviors because they fail to appropriately regulate their behavior, they may also make use of their cognitive capacities to achieve the goal of engaging in risky or risk-taking behaviors because they *want* to do so. Distinguishing between these two cases can be hard, even when we have data about adolescents’ motives. Our goal in this essay is to provide a framework to understand the relationship between adolescent risky/risk-taking behaviors and self-control. To this aim, we build on the work of the philosopher Harry Frankfurt regarding free will (Frankfurt, 1971) to devise a scheme for justifi-

ably inferring whether a given behavior did or did not involve a failure of self-control.

## Risky behaviors, self-control, and conflicting goals

Classifying behaviors as failures of self-control, as opposed to objectively risky but deliberate decisions, is a tricky business. But while the problem is complex, the source of the difficulty is actually straightforward. In the context of risk-taking behaviors, when someone fails to self-control their behavior they actually end up doing things they *want* to do. You certainly never heard someone say, “I couldn’t control myself, so I ate that whole salad!”, or “I couldn’t resist going to the dentist!”. Most behaviors recognized as failures of self-control happen when people actually have some reason for doing what they did. The key to these situations is that there is also a reason for *not* doing what they did. A conflict of goals, objectives, or desires lies at the heart of the self-control conundrum.

The issue of conflicting goals and its implications for understanding peoples’ decisions (or their “freedom of will”) was taken up by the philosopher Harry Frankfurt in his classic 1971 essay “*Freedom of the Will and the Concept of a Person*” (Frankfurt, 1971). Key to Frankfurt’s reasoning are the concepts of first- and second-order desires. The concept of first-order desires refers to, in Frankfurt’s words, the “wanting and choosing and being moved *to do this or that*” (pp. 7, emphasis in the original). These are goals and desires that individuals have, which can move them to make certain decisions (of action or inaction) and even to engage their cognitive functions for attaining their goals. Importantly, an individual can have multiple, and conflicting, first-order desires. I may wish to eat the cake *and* to lose weight – or to write this essay and to check out what is happening on social media (or really to do anything but work). In such cases of conflict, one of the desires will be an *effective* desire – the “one that moves (or will or would move) a person all the way to action” (pp. 8). Accordingly, an adolescent may want to stay safe/avoid harm *and also* to drink, smoke, have sex, and the like, but only one of these desires will be the final mover his/her actions.

Here enters the concept of second-order desires. These are desires about desires – what a person *wants* to want (for example, wishing to have a desire for salad, or wishing not to have desire for cake). These second-order desires may also take the form of a desire about which of the conflicting desires the person wants to be the *effective* desire – that is, what goal/desire that person wants to be moved by. Frankfurt called this later type of second-order desire – about what desire the person wants to be moved by – second-order *volitions*, and they are the crucial point here. For instance, one may have conflicting desires for eating cake and losing weight, and one may want both to procrastinate and to get work done, but this is just half the story. The person may not be ambivalent to these conflicting desires – they may have a preference about which desire or goal should be the mover of their actions.

For Frankfurt, having second-order volitions is the basis of any meaningful claim to free will<sup>2</sup>. For us, this concept offers the gateway to understand self-control in the face of conflicting goals. Ultimately, the accordance of people’s actions with their second-order volitions is the standard by which they can tell whether they succeeded or failed in self-controlling their behavior.

## Putting the concept to work – a few concrete examples

Let us now take these concepts and go back to adolescents’ risky behaviors. To understand how Frankfurt’s formulation maps onto the problems in adolescent behavior it is best to have a concrete example. Consider the case of a 16-year-old who went to a party and consumed a significant amount of alcohol. Under the dual systems view, one would interpret this behavior as a failure of self-control caused by increased sensation seeking/reward sensitivity (triggered by the prospect of a rewarding experience) and poor self-control (which failed to pull the breaks on a behavior that can have serious negative consequences).

Of course, adolescents who drink alcohol usually do so because they want to, for any number of reasons they find potentially rewarding – from pure sensation-seeking to the desire of looking cool/tough or fitting in. Whatever the reason, we can say the adolescent did what he wanted to do. We can also say, however, that there are objective reasons for not engaging in this behavior – reasons that the adolescent may or may not acknowledge. Thus, based on the behavior alone, it is not possible to tell whether there were conflicting goals to begin with, a necessary element for the behavior to constitute a failure of self-control. It is also not possible to tell if this behavior was a risk-taking behavior, in which case the risks are known to the individual, or just a risky one, in which case the risk is unknown, unclear, or unacknowledged by the individual. So, before calling a failure of self-control, we need more information.

We are now going to add more information to the scenario above to create alternative backgrounds for the same behavior. The point is to show how differences in the details can lead to different interpretations for the causes and meaning of the behavior. To this aim, we will consider four scenarios:

1. In the first one, our drinking adolescent is unaware of the existence and seriousness of the risks involved in drinking alcohol (and of the particular risks involved in *adolescents* drinking alcohol), and so he decides to drink based on his current (and objectively misguided) assessment of the risk.
2. In a second, similar scenario, the adolescent has knowledge about the existence and seriousness of risks involved, but does not care about avoiding them, simply following his desire to drink.

<sup>2</sup>A debatable claim, which depends on one’s definition of free will and philosophical stance. But these issues are not directly relevant to the present discussion.

3. In the third scenario, the adolescent knows the risks and has an adequate (objective) sense of their severity. He also believes that, by themselves, these risks should be avoided, and may even be genuinely afraid of them. Yet, for a variety of reasons, he wants to drink, and upon reflection he is of the opinion that the experience of drinking is worth the risk.
4. In the fourth scenario, the adolescent knows the risks, is concerned about/afraid of them, and wishes to avoid them. In fact, under calm and controlled circumstances, he would say drinking is not worth the risk. However, in the heat of the moment the adolescent does drink, later regretting that decision.

We think most people would agree that the first three cases above are just poor choices (at least from our supposedly objective perspective as adult observers), while the fourth scenario is a *bona fide* failure of self-control. And there are good reasons for agreeing with that intuition. In the first two scenarios, the adolescent has no conflict of goals/desires to prevent him from drinking – in the first scenario the adolescent lacks the knowledge needed to have an informed and reasonable appreciation of (the severity of) the risks involved in his behavior, while in the second he has the knowledge but does not care about or take these risks seriously. Since there is no reason to avoid drinking in these cases, there can be no failure in self-control in doing so because inhibiting that behavior was not even a goal. In fact, the drinking behavior in these cases is not even a risk-taking behavior, just a risky one.

The third scenario is different. In this case the adolescent had the information required to assess the risks and had the relevant standards – that the risks involved are bad and should be avoided. This view of the risk can be thought of as a first-order desire – a desire to be safe. However, there is another, conflicting first order desire – the desire to drink (for whatever reason the adolescent has). The adolescent had to deal with the conflict between these first-order desires and derive from that a preferred desire – a second-order volition, regarding which of these conflicting desires (drinking or being safe) he wishes to be his effective desire. If the adolescent thinks, as in this case, that the experience is worth the risk, then the resulting behavior cannot be regarded as a failure of self-control. The behavior was a deliberate choice as the adolescent was not neutral regarding which of his desires was the mover of his action, and he behaved according to that preference. It is worth noting that in this case we do have a risk-taking behavior because the adolescent is aware of the risks, but since the behavior did not go against the adolescent's will it is nonetheless not a failure of self-control.

This leaves us the fourth scenario. Here we have a conflict of first order desires, like in the previous scenario: the adolescent knows the risks associated with drinking, and while he wants to drink, he also wants to stay clear of its risks. And again, the adolescent is not neutral about which of these desires is the mover of his actions. But unlike the third scenario, the adolescent here actually wants to be moved by the risk-

avoiding side of his conflicting desires (a second order volition). And yet, in the end, he goes against this second-order volition. Crucially, the final behavior does conform with *one* of his first order desires, so he did something that he wanted to do. However, he did not behave according to the desire that he wished was the *driver of his will*. This break from his second-order volition is what lead to the subsequent regret<sup>3</sup>. So this is, indeed, a risk-taking behavior that resulted from a self-control failure – of a kind that would generally be regarded as stemming from impulsive action. (Of note, the specific source of the failure may lie in a number of different cognitive processes, as we discuss in Box 2.)

It is interesting to note that a similar structure to the fourth case discussed above could lead to a “conservative” behavior around drinking that is nonetheless a failure of self-control. To see this, consider again the case of an adolescent who wants to drink but is afraid of doing so because of the risks. If this adolescent has a second order volition of drinking to be his ultimate behavior – that is, he wishes to go past his fear of the risks (a first order desire of being safe) to have the experience of drinking (his conflicting first order desire) – then not drinking in this case would technically be a failure of self-control! Yet no study on adolescent risk-taking would ever classify this behavior as so – in fact, this adolescent would be seen as having greater self-control than his drinking peers.

The scenarios above make it clear that the actual behavior does not indicate whether self-control failed or not. A risky behavior can only be regarded as a failure of self-control if we can establish that an individual: 1) knew the risks involved; 2) had a conflict between a desire for doing the behavior in question and a desire to avoid the risks associated with that behavior; 3) had a second order volition towards avoiding the risks; and 4) failed to act according to that second order volition.

Notice that the four scenarios above have distinct implications for how to prevent adolescents from engaging in risky or risk-taking behaviors. Cases like the first scenario require providing information about the risks of drinking, and both the first and second scenarios require making sure adolescents internalize the severity of those risks. This could partly prevent these adolescents from engaging in such activities if they are convinced by the potential severity of the risks (assuming they have adequate levels of self-control). Differently, cases like our fourth scenario involve a specific problem with self-control which could be partly remediated with interventions that help improve this capacity (e.g., Duckworth et al., 2016). Finally, adolescents akin to our third scenario are not uninformed nor necessarily lack self-control. They just need better priorities (at least from the zealous adults' perspective).

<sup>3</sup>Of note, regret should not be taken as a specific marker of self-control failure. Regretting doing something in retrospect when at the time of the behavior there was no second-order volition against it does not figure as a self-control failure.

## Implications for the study of self-control in adolescent risk-taking

The discussion above has important implications for how we study and interpret adolescent risk-taking and risky behaviors. Adolescent risk-taking in the real world has traditionally been studied using self-reported questionnaires about the occurrence and frequency of common risky behaviors such as consuming alcohol, smoking cigarettes or using other drugs, having unprotected sex, or engaging in risky driving (Duell et al., 2018; Defoe et al., 2022). As we illustrated above, by themselves these questionnaires do not inform us about failures in self-control.

Such information about real-world behaviors is often complemented by questionnaires assessing constructs such as sensation-seeking and impulsivity, believed to be related to those risky behaviors (Steinberg, 2007; Steinberg, 2008; Steinberg et al., 2008; Shulman et al., 2016). Of note, while these later instruments may be informative, they are not able to tell whether adolescents' risky behaviors are indeed failures of self-control. In fact, contrary to common beliefs, sensation-seeking and cognitive control (see Box 1) are not really antipoles, and high sensation seeking only seems to lead to impulsive behaviors when accompanied by poor self-control (Romer et al., 2017; Icenogle and Cauffman, 2021). Impulsivity scores are also tricky to interpret, because impulsiveness can be highly context-sensitive (Tsukayama et al., 2011). Furthermore, the concept of impulsivity is not a unitary one, as it encompasses many separate cognitive processes that seem to have distinguishable biological bases (Strickland and Johnson, 2021). It follows that we should not use unspecified "impulsiveness" scores to infer the causes of a particular instance of behavior. For example, one might lose control when trying to regulate overeating but this does not necessarily mean the same person will have difficulties in refraining from drinking. It should also be kept in mind that while sensation seeking and impulsivity scores tend to reduce with age (Steinberg et al., 2008; 2018), many so-called risk behaviors, such as drinking alcohol, continue to increase throughout the third decade of life (Duell et al., 2018).

In addition to the use of questionnaires, risk-taking is also investigated with laboratory tasks involving decision-making under risk and uncertainty, usually involving rewards in the form of material gains or points (Defoe et al., 2015). But while these laboratory-based tasks can be insightful, the relation between them and real-world behaviors is usually unclear (Defoe et al., 2015; Defoe and Romer, 2022). Partly because of this, questionnaires are still the main tool for investigating real-world risky and risk-taking behaviors, as their questions are directly related to the behaviors of interest. Of course, there is no guarantee that people actually behave according to the answers they give in the questionnaires, and the fact that questionnaires are cheap and easy to administer certainly plays a role in their widespread use as well.

The main problem with questionnaires used to date, which focus on these issues, is that they do not provide enough information to interpret the behaviors they intend to assess. As illustrated by our examples above, the mere occur-

rence of a risky behavior is not enough to determine whether or not it is a self-control failure – or even a risk-taking behavior instead of just a risky one. And as noted above, this has important implications for developing strategies to help adolescents avoid those risks.

Recently, some research groups have started to shift the focus from the mere occurrence and frequency of risky behaviors to inquiries about the actual reasons why adolescents engage in such behaviors (Defoe et al., 2022). This field of research is motivated by new models that diverge from the dual-systems approach in trying to explain adolescent behavior, such as the *Developmental Neuro-Ecological Risk-taking Model* (Defoe, 2021) and the *Life-span Wisdom Model* (Romer et al., 2017). As stated above, these studies revealed that adolescents engage in risky behaviors for a variety of reasons. But while this is a step forward, it is not enough. That adolescents have reasons to do what they do is expected, but if they experience self-control failure than those reasons are just one side of the conflict of goals that led to the behavior. Crucially, these questionnaires do not inform us about the second-order volitions the adolescents may hold, and whether these were in line with the adolescents' decisions on how to act.

Whatever the chosen framework about adolescent cognitive development and its relation to risky behaviors, we will still need a way to investigate whether a given behavior is or is not a failure of self-control. And to make that call we need more information than is usually inquired about. Based on our discussion above, we propose that, beyond probing about the occurrence of risky behavior undertaken by adolescents, future research should request additional data in order to draw conclusions about self-control and to distinguish between risky and risk-taking behaviors. First, the questionnaires should ask about adolescents' knowledge of the risks involved in the behaviors of interest. Second, these instruments must establish whether the adolescents agree that these risks are serious and should be avoided – i.e., that they understand the risks and wish to stay clear of them. In fact, there are already instruments that could be used for these purposes, such as Benthin et al.'s (1993) Risk Perception Scale. These two pieces of information should then be combined with the already-in-use questions about adolescents' reasons for engaging in risky behaviors, which can also provide information on the context in which risk-taking is more prevalent. With these three pieces of information it would be possible to establish a conflict of goals or desires, a necessary requirement for behaviors to be labeled as self-control failures.

Crucially, a fourth type of information should also be collected, concerning adolescents' meta-cognitive assessment of their own behavior. Did they behave as they wanted to behave then and there? Do they believe they were unable to control themselves at that instant? These types of questions are already used in some lines of research, such as those investigating eating disorders (e.g., Latner et al., 2014). They should also be used in the field of adolescent risky behaviors. These questions are key to discerning why adolescents did what they did – whether their behavior was a failure of self-

control or a deliberate decision – and to address these risky behaviors appropriately. Because self-control capacities must serve a goal – there is no regulation or control without a goal – the best judges of self-control failures should always be the individuals themselves. If researchers fail to acknowledge this, they may end up crying self-control failures based on their own standards, not on the standards of the behaving person. In adolescence research, this amounts to a biased view of adolescents' self-control capacities based on adult-set social norms about the appropriate behavior for adolescents, while ignoring their capacity to assess risks and their volitions. This is a fallacy that considerably limits the possibility of forming a scientific theory about adolescent behavior and finding adequate interventions to reduce adolescents' vulnerability to risky and risk-taking behavior.

## Conclusions

Risk-taking is one of the most studied aspects of adolescent behavior. The attention to this facet of adolescent behavior is understandable. After all, adolescence is a critical developmental period during which the possible negative consequences of risky behaviors can be even more serious than they are for adults. It is still common to see adolescence described as a time of peak risk-taking driven by poor self-control, but it is increasingly recognized that the evidence does not support this view and that a more nuanced perspective is warranted. In fact, while the passing of adolescence sees gradual reductions in sensation-seeking and impulsivity, along with increased self-control, the incidence of commonly studied social- and health-related risky behaviors only peak after adolescence, in the third decade of life (Duell et al., 2018).

Although opportunities to engage in risky behaviors certainly increase with age, which can explain why young adults incur in more risky behaviors, many studies consider some behaviors as risk-taking only if carried out by adolescents, which can partly account for the view that teenagers are higher risk takers. For example, many researchers stop seeing as “risk-taking” behaviors like having sex, drinking, and so on, once people are over the legal age for these behaviors. One may argue that this change of perspective about what constitutes risky actions across ages is justified by the differential severity of the risks involved for adolescents and adults. However, we wonder if there is any change, from adolescence to early adulthood, in the psychobiological processes underlying these behaviors that would justify seeing them as fundamentally different between age groups. In fact, we would argue that much of what is discussed in this paper about how to interpret the relationship between risky behaviors and self-control in adolescents would apply equally well to adults.

Our main argument in this essay is that we need to clarify the relationship between risky behaviors and self-control if we are to understand this side of adolescent behavior – and if we are to develop efficient strategies to prevent potentially harmful behaviors. We believe the conceptualization offered in this essay, based on Frankfurt's work, can offer

a way forward in these respects. Putting adolescents' goals and desires, along with their second-order volitions, on center stage would prevent researchers from relying too much on their own standards when investigating adolescent behavior. This would also help balance considerations of objective risks against the will and preferences of individuals regarding risky behaviors, thus preventing us from misinterpreting adolescent risky behaviors as always resulting from failures of self-control – and as fundamentally different from adult behaviors. The perspective offered here also puts a spotlight on the variety of scenarios that can underlie risky behaviors, each requiring its own set of strategies in order to prevent adolescents from engaging in unnecessary risks.

## ACKNOWLEDGEMENTS

This work was supported by the São Paulo Research Foundation (FAPESP: process numbers 2016/14750-0, and 2019/11706-8), the Coordination for the Improvement of Higher Education Personnel (CAPES: finance code 001), the Research Incentive Fund Association (AFIP), and the Brazilian National Council for Scientific and Technological Development (CNPq: process number 301899/2019-3).

### **Box 1 – Defining self-control**

There are different definitions of self-control available in the literature, and the term is often used interchangeably with self-regulation (e.g., Baumeister and Heatherton, 1996; Heatherton and Wagner, 2010) and cognitive control (e.g. Shulman et al., 2016). That said, we take self-control and self-regulation/cognitive control to be different concepts and, for the purposes of our discussion, we will follow the line of commonly used definitions that puts self-regulation/cognitive control as broader terms, encompassing self-control. Specifically, we define self-regulation/cognitive control as the set of abilities that enable adaptive goal-directed behavior (Carver and Scheier, 1998; Hofmann et al., 2012; Nigg, 2017; Amaya, 2020). This definition is admittedly broad and encompasses or requires many different capacities, from attention and working memory to emotional regulation and executive functions like shifting, inhibition, updating, planning, etc.

The concept of self-control is a narrower one and refers to a subset of the capacities related to self-regulation. In particular, self-control refers to top-down components of self-regulation (Nigg, 2017) employed to resolve motivational conflicts (Amaya, 2020) and help override (or inhibit) unwanted impulses and urges (Carver and Scheier, 1998; Hofmann et al., 2012). This definition is not very far from how the term is used and understood in everyday life, and variations of it are commonly used in the psychological literature, either when working directly with the construct of self-control or indirectly when working with inhibition (often taken as a synonym of self-control) and its antipode, impulsivity, which is generally deemed as a failure of self-control.

For the present discussion we will refer to “self-control” when discussing adolescent risky behaviors. The reason for this choice is that risk-taking is usually framed as involving motivational conflicts between the rewards associated with a given behavior and the desire to avoid the potential harms associated with that same behavior. Hence, the narrower concept of self-control is more directly relevant here, and the definition of self-control provides a better description of the cognitive abilities that supposedly malfunction in adolescents and lead to risk-taking according to the dual-systems models.

## **Box 2 – Causes of self-control failures**

While the adolescent in our fourth scenario above failed in self-control, the framework we are discussing so far based on Frankfurt's work does not really tell us why that failure happened. In fact, there are different reasons why someone may fail to self-control. There is a conceptualization we find particularly useful for analyzing such failures, based on the discussion by Baumeister and Heatherton (1996), and on a slightly different formulation made by Hoffman et al. (2012), which are themselves based on work by Carver and Scheier (later summarized in their 1998 book). The idea is that self-control requires three things: standards (and the monitoring thereof), motivation, and capacity.

By standards, we mean what the individual deems to be the "correct" course of action in a given context (regardless of whether the individual's beliefs are objectively correct). Importantly, the individual not only needs to have the appropriate standards, but needs to monitor them – to keep them in mind at the time of decision-making. (Of note, as per our discussion of in the main text, we do not take lack of standards to be a failure of self-control. Apparent failures of self-control resulting from problems in the standards just mean that the behaving person and the observer have different information or different standards.)

By motivation, we mean what the individual actually wants to do in a given situation. This may or may not align with the individual's standards, and there may be conflicting motivations, as per our discussion of first-order desires and second-order volitions in the main text. As we saw in the main text, some combinations of these may be involved in failures of self-control, while others may not. It all depends on the agreement between the behavior and the second-order volitions.

Finally, capacity means the individual's aptitude in actually doing what s/he wants to do. In cases where there are conflicting goals/desires, these capacities must be harnessed to exert top-down control over behavior, as per our definition of self-control. This 'capacity' component involves several cognitive abilities, such as controlled attention, working memory, emotional regulation, and so on. These same capacities may also be involved in the monitoring of standards noted above.

A failure at any of these processes can lead to a self-control failure. But because there are many capacities involved in regulating the processes above, the specific process involved in the failure may have different implications for how to prevent such failures in the future. For example, one may fail to self-control because of problems in emotional regulation, but also due to deficient working memory, important for goal and standard monitoring and to "shield" the relevant standards during decision-making, keeping them in mind long enough for them to influence behavior, among others. Each of these must be addressed differently. The "burden" on self-control-related capacities is also important for the outcome, as individuals may be differentially "tempted" in different domains. That is, where temptations are greater, the strain on the self-control abilities is more likely to overcome them (Tsukayama et al., 2011).

## Bibliography

- Amaya, S. (2020). The Science of Self-Control. Available at <https://www.templeton.org/wpcontent/uploads/2020/08/JTF-Self-Control-Final.pdf>
- Baumeister, R. F., Heatherton, T. F. (1996). Self-Regulation Failure: An Overview. *Psychological Inquiry*, 7(1), 1–15. <https://doi.org/10.1207/s15327965pli07011>
- Benthin, A., Slovic, P., Severson, H. (1993). A psychometric study of adolescent risk perception. *Journal of adolescence*, 16(2), 153–168. <https://doi.org/10.1006/jado.1993.1014>
- Carver, C. S., Scheier, M. F. (1998). *On the Self-Regulation of Behavior* (1st ed.). Cambridge University Press. <https://doi.org/10.1017/CBO9781139174794>
- Casey, B., Galván, A., Somerville, L. H. (2016). Beyond simple models of adolescence to an integrated circuit-based account: A commentary. *Developmental Cognitive Neuroscience*, 17, 128–130. <https://doi.org/10.1016/j.dcn.2015.12.006>
- Casey, B. J. (2015). Beyond Simple Models of Self-Control to Circuit-Based Accounts of Adolescent Behavior. *Annual Review of Psychology*, 66(1), 295–319. <https://doi.org/10.1146/annurev-psych-010814-015156>
- Defoe, I. N. (2021). Towards a hybrid criminological and psychological model of risk behavior: The developmental neuroecological risk-taking model (DNERM). *Developmental Review*, 62, 100995. <https://doi.org/10.1016/j.dr.2021.100995>
- Defoe, I. N., Dubas, J. S., Figner, B., van Aken, M. A. G. (2015). A meta-analysis on age differences in risky decision making: Adolescents versus children and adults. *Psychological Bulletin*, 141(1), 48–84. <https://doi.org/10.1037/a0038088>
- Defoe, I. N., Rap, S. E., Romer, D. (2022). Adolescents' own views on their risk behaviors, and the potential effects of being labeled as risk-takers: A commentary and review. *Frontiers in Psychology*, 13, 945775. <https://doi.org/10.3389/fpsyg.2022.945775>
- Defoe, I. N., Romer, D. (2022). Theoretical advances in research on the development of risk taking. *Developmental Review*, 63, 101001. <https://doi.org/10.1016/j.dr.2021.101001>
- Duckworth, A. L., Gendler, T. S., Gross, J. J. (2016). Situational Strategies for Self-Control. *Perspectives on Psychological Science*, 11(1), 35–55. <https://doi.org/10.1177/1745691615623247>
- Duell, N., Steinberg, L., Icenogle, G., Chein, J., Chaudhary, N., Di Giunta, L., Dodge, K. A., Fanti, K. A., Lansford, J. E., Oburu, P., Pastorelli, C., Skinner, A. T., Sorbring, E., Tapanya, S., Uribe Tirado, L. M., Alampay, L. P., Al-Hassan, S. M., Takash, H. M. S., Bacchini, D., Chang, L. (2018). Age Patterns in Risk Taking Across the World. *Journal of Youth and Adolescence*, 47(5), 1052–1072. <https://doi.org/10.1007/s10964-017-0752-y>
- Ernst, M. (2014). The triadic model perspective for the study of adolescent motivated behavior. *Brain and Cognition*, 89, 104–111. <https://doi.org/10.1016/j.bandc.2014.01.006>
- Ernst, M., Pine, D. S., Hardin, M. (2006). Triadic model of the neurobiology of motivated behavior in adolescence. *Psychological Medicine*, 36(3), 299–312. <https://doi.org/10.1017/S0033291705005891>
- Frankfurt, H. G. (1971). Freedom of the Will and the Concept of a Person. *The Journal of Philosophy*, 68(1), 5. <https://doi.org/10.2307/2024717>
- Galvan. (2010). Adolescent development of the reward system. *Frontiers in Human Neuroscience*. <https://doi.org/10.3389/neuro.09.006.2010>
- Heatherton, T. F., Wagner, D. D. (2011). Cognitive neuroscience of self-regulation failure. *Trends in Cognitive Sciences*, 15(3), 132–139. <https://doi.org/10.1016/j.tics.2010.12.005>
- Hofmann, W., Schmeichel, B. J., Baddeley, A. D. (2012). Executive functions and self-regulation. *Trends in Cognitive Sciences*, 16(3), 174–180. <https://doi.org/10.1016/j.tics.2012.01.006>
- Icenogle, G., Cauffman, E. (2021). Adolescent decision making: A decade in review. *Journal of Research on Adolescence*, 31(4), 1006–1022. <https://doi.org/10.1111/jora.12608>
- Jessor, R. (2018). Reflections on Six Decades of Research on Adolescent Behavior and Development. *Journal of Youth and Adolescence*, 47(3), 473–476. <https://doi.org/10.1007/s10964-018-0811-z>
- Latner, J. D., Mond, J. M., Kelly, M. C., Haynes, S. N., Hay, P. J. (2014). The loss of control over eating scale: Development and psychometric evaluation: Loss of Control Over Eating Scale. *International Journal of Eating Disorders*, 47(6), 647–659. <https://doi.org/10.1002/eat.22296>
- Maslowsky, J., Owotomo, O., Huntley, E. D., Keating, D. (2019). Adolescent Risk Behavior: Differentiating Reasoned And Reactive Risk-taking. *Journal of Youth and Adolescence*, 48(2), 243–255. <https://doi.org/10.1007/s10964-018-0978-3>
- Nigg, J. T. (2017). Annual Research Review: On the relations among self-regulation, self-control, executive functioning, effortful control, cognitive control, impulsivity, risk-taking, and inhibition for developmental psychopathology. *Journal of Child Psychology and Psychiatry*, 58(4), 361–383. <https://doi.org/10.1111/jcpp.12675>
- Peeters, M., Oldehinkel, A., Veenstra, R., Vollebergh, W. (2019). Unique developmental trajectories of risk behaviors in adolescence and associated outcomes in young adulthood. *PLOS ONE*, 14(11), e0225088. <https://doi.org/10.1371/journal.pone.0225088>
- Romer, D., Reyna, V. F., Satterthwaite, T. D. (2017). Beyond stereotypes of adolescent risk taking: Placing the adolescent brain in developmental context. *Developmental Cognitive Neuroscience*, 27, 19–34. <https://doi.org/10.1016/j.dcn.2017.07.007>
- Shulman, E. P., Smith, A. R., Silva, K., Icenogle, G., Duell, N., Chein, J., Steinberg, L. (2016). The dual systems model: Review, reappraisal, and reaffirmation. *Developmental Cognitive Neuroscience*, 17, 103–117. <https://doi.org/10.1016/j.dcn.2015.12.010>
- Steinberg, L. (2007). Risk Taking in Adolescence: New Perspectives From Brain and Behavioral Science. *Current Directions in Psychological Science*, 16(2), 55–59. <https://doi.org/10.1111/j.1467-8721.2007.00475.x>
- Steinberg, L. (2008). A social neuroscience perspective on adolescent risk-taking. *Developmental Review*, 28(1), 78–106. <https://doi.org/10.1016/j.dr.2007.08.002>
- Steinberg, L., Albert, D., Cauffman, E., Banich, M., Graham, S., Woolard, J. (2008). Age differences in sensation seeking and impulsivity as indexed by behavior and self-report: Evidence for a dual systems model. *Developmental Psychology*, 44(6), 1764–1778. <https://doi.org/10.1037/a0012955>
- Steinberg, L., Cauffman, E., Woolard, J., Graham, S., Banich, M. (2009). Are adolescents less mature than adults?: Minors' access to abortion, the juvenile death penalty, and the alleged APA "flip-flop." *American Psychologist*, 64(7), 583–594. <https://doi.org/10.1037/a0014763>
- Steinberg, L., Icenogle, G., Shulman, E. P., Breiner, K., Chein, J., Bacchini, D., Chang, L., Chaudhary, N., Giunta, L. D., Dodge,

- K. A., Fanti, K. A., Lansford, J. E., Malone, P. S., Oburu, P., Pastorelli, C., Skinner, A. T., Sorbring, E., Tapanya, S., Tirado, L. M. U., ... Takash, H. M. S. (2018). Around the world, adolescence is a time of heightened sensation seeking and immature self-regulation. *Developmental Science*, 21(2), e12532. <https://doi.org/10.1111/desc.12532>
- Strickland, J. C., Johnson, M. W. (2021). Rejecting impulsivity as a psychological construct: A theoretical, empirical, and sociocultural argument. *Psychological review*, 128(2), 336–361. <https://doi.org/10.1037/rev0000263>
- Tsukayama, E., Duckworth, A. L., Kim, B. (2012). Resisting Everything except Temptation: Evidence and an Explanation for Domain-specific Impulsivity. *European Journal of Personality*, 26(3), 318–334. <https://doi.org/10.1002/per.841>
- Tymula, A., Rosenberg Belmaker, L. A., Roy, A. K., Ruderman, L., Manson, K., Glimcher, P. W., Levy, I. (2012). Adolescents' risk-taking behavior is driven by tolerance to ambiguity. *Proceedings of the National Academy of Sciences*, 109(42), 17135–17140. <https://doi.org/10.1073/pnas.1207144109>
- Willoughby, T., Heffer, T., Good, M., Magnacca, C. (2021). Is adolescence a time of heightened risk taking? An overview of types of risk-taking behaviors across age groups. *Developmental Review*, 61, 100980. <https://doi.org/10.1016/j.dr.2021.100980>