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**Title: ARE HEALTH PROTECTIVE BEHAVIORS PROMOTED BY ANTICIPATED  
REGRET?**

Short running title: ANTICIPATED REGRET AND HEALTH PROTECTIVE BEHAVIORS

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**DECLARATIONS OF CONFLICTING INTEREST**

The Authors declare that there is no conflict of interest.

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**RESEARCH ETHICS AND PARTICIPANTS CONSENT**

The research was pre-approved by the protection data officer of the institution.

In accordance with international norms governing the use of human research participants, written informed consent was obtained from all the participants, and adolescents provided online parental consent in accordance with the Declaration of Helsinki.

#### **DATA AVAILABILITY STATEMENT**

The authors confirm that the data supporting the findings of this study are available within the article or its supplementary materials.

#### **Abstract**

Several factors influence the adoption of health-protective behaviors, including anticipatory affective reactions like regret. The ability to anticipate regret matures with age, allowing individuals to make increasingly risk-averse decisions. This study examined the relationship between age and the adoption of health-protective behaviors to limit the spread of a virus from adolescence to adulthood, and the mediating effect of anticipated regret. A total of 410 French participants, aged 14 to 58, reported their compliance with health-protective behaviors (e.g. using surgical masks, handwashing, social distancing), along with their anticipated regret in the event of non-adherence to such behaviors leading to the contamination of themselves or others. The findings revealed that both the adoption of these behaviors and anticipated regret increased with age. Moreover, anticipated regret mediated the effect of age on health-protective behavior, encouraging higher compliance with preventive measures and reducing risk-taking.

**Key-words:** Public Health, Regret, Risk-taking, Adolescence, Adulthood



## INTRODUCTION

In recent years, theoretical models of motivation and engagement in health behaviors have increasingly integrated affective concepts such as anticipated emotions (Brewer et al., 2016). Based on the theory of planned behavior (Sandberg and Conner, 2008), the extant literature indicates that individuals' negative affective states exert both indirect and direct effects on health behaviors. Engagement in health behaviors encompasses all actions aimed at improving or maintaining health, such as abstaining from alcohol consumption, refraining from smoking, or using surgical masks (e.g., in a contaminated area), among others (Capasso et al., 2021; Conner et al., 2017; Kirscht, 1983; McEachan et al., 2016; Stevens et al., 2019). This engagement has been studied in particular in the health belief model (Abraham and Sheeran, 2001), comparing the attitudes and beliefs of adolescents and adults in order to develop the most effective prevention programs for reducing adolescent risk-taking (alcohol use, sexual protection). The COVID-19 pandemic provided a unique opportunity to study the impact of an anticipated emotion, namely anticipated regret, on the adoption of health-protective behaviors in response to a novel health risk from adolescence to adulthood. Numerous countries implemented preventive measures to limit the spread of the pandemic, notably the use of surgical masks and social distancing. While the elderly and chronic-disease patients were the most vulnerable (Zheng et al., 2020), adolescents' and young adults' adherence to protective behaviors was essential to control the spread of COVID-19 (Andrews et al., 2020; Pasion et al., 2020). However, as these behaviors are implemented at the individual level, there is considerable variation in their manifestation.

Prior research on health behaviors suggests a linear relationship between age and health and safety decisions among adults, such as protective behaviors (Pasion et al., 2020). Older adults seem to engage in adaptive self-regulation, making more self-protective decisions (Västfjäll et al., 2011; Wrosch and Heckhausen, 2002). In contrast, adolescents

appear more likely to make risky health decisions, including alcohol use, tobacco use, unhealthy dietary behaviors, and risky sexual behaviors (Albert and Steinberg, 2011; Resnick et al., 1997). Adolescents were also more likely to engage in risky health behaviors related to COVID-19 (Dardas et al., 2020; Zhong et al., 2020). One mediating factor that may account for this age-related difference is anticipated regret (Brewer et al., 2016).

Regret occurs when we realize that our current situation could have been better if we had decided differently (Camille et al., 2004; Habib and Cassotti, 2015; Zeelenberg et al., 2008). The anticipation of regret is contingent upon one's capacity to predict the circumstances under which regret may arise and the degree to which it may be experienced (Mellers, 2000). Given the unpleasant nature of regret, people will try to avoid making decisions they may later regret (Camille et al., 2004; Habib and Cassotti, 2015; Pieters and Zeelenberg, 2007). Regret, in its anticipated or post-decisional instances, therefore represents a form of emotional learning (Camille et al., 2004; McCormack et al., 2020) that has been associated to the desire to improve oneself and to correct past mistakes (Breugelmans et al., 2014). For example, regret can influence individuals' risk-taking behavior: participants who anticipate regret the most before deciding would also be the least likely to take risks (Sandberg and Conner, 2008; Smerecnik and Ruiter, 2010). The same positive effect of anticipated regret has been observed in the context of the adoption of health-protective behaviors (Sandberg and Conner, 2008; Smerecnik and Ruiter, 2010). Anticipated regret is a significant factor contributing to the observed variation in the adoption of health-protective behaviors among adults (Richard et al., 1996; Sandberg and Conner, 2008; Smerecnik and Ruiter, 2010).

Regret avoidance is already at play during adolescence (Feeney et al., 2018; Richard et al., 1996). However, while some studies reported that anticipated regret can positively influence the adoption of health-protective behavior during adolescence (Caffray and

Schneider, 2000; Richard et al., 1996; Van Der Pligt and Richard, 1994), others have found that this effect diminishes when negative consequences are perceived to occur in the distant future (Brown et al., 2011). Adolescents are generally perceived as taking more risks than adults (Habib et al. 2023), and past studies indicate that adolescence is a period characterized by increased risk behaviors, such as higher levels of substance abuse or unprotected sex (Dahl, 2004). Understanding health protective behaviors across ages is therefore an issue of public health. Capasso et al. (2021) investigated the effect of exposure to messages targeting cognitive attitude, combined with regret reactions on intentions to get vaccinated against COVID-19. The study revealed that participants exposed to regret did not report higher intentions to get vaccinated compared with participants in the control group. However, this study examined the manipulation of a message aiming at promoting vaccination, and did not examine the impact of the emotions felt by the participants on the intention to get vaccinated.

In the present study, we aimed to explore (i) whether the adoption of health-protective behaviors in the context of COVID-19 pandemic (French Ministry of Health and Solidarity, 2020) increased from adolescence to adulthood (Caffray and Schneider, 2000; Richard et al., 1996; Van Der Pligt and Richard, 1994), and (ii) whether the latter increase was mediated by an increase in anticipated regret with age. We hypothesized that both the adoption of protective behaviors and the anticipation of regret would increase with age (Feeney et al., 2018; Habib et al., 2012; McCormack and Feeney, 2015; Pasion et al., 2020) and that the relationship between age and protective behaviors would be mediated by the experience and anticipation of regret (Brewer et al., 2016; Pența et al., 2020).

## **METHOD**

### *Participants*

465 native French speakers, recruited via social networks, volunteered to complete an online questionnaire. Fifty-five participants were excluded for not fully completing the



questionnaire. The final sample consisted of 410 participants: 109 adolescents (76 women, aged 14-19; see Table 1), 197 young adults (136 women; aged 20-29) and 104 middle-aged adults (96 women; aged 30-58). The age ranges were selected based on the findings of previous research in the healthcare field (Katanoda et al., 2017).

In accordance with international norms governing the use of human research participants, written informed consent was obtained from all the participants, and adolescents provided online parental consent in accordance with the Declaration of Helsinki. The research design and questionnaire were submitted to and approved by the institution's data protection officer.

The distributions of areas of residence and adults' socio-professional categories are reported in the supplementary material. Data were collected between December 2020 and May 2021. This period corresponded to the second epidemic wave in France, which led to lockdowns, curfews and social withdrawal, and occurred before eligibility for COVID-19 vaccination.

#### *Measures and procedure*

Participants filled a 27-item questionnaire using 10-point Likert scales. First, they answered five demographical questions. Next, they answered 18 items based on six types of preventive measures recommended by the French government (French Ministry of Health and Solidarity, 2020). This section assessed their adherence to six types of protective behaviors: wearing a surgical mask; handwashing; coughing and sneezing into your elbow; avoiding touching face; social distancing greetings; restricting social contacts. Subsequently, based on previous studies measuring regret feeling and anticipated regret (Smerecnik and Ruiters, 2010; Zeelenberg et al., 1998), participants answered four items designed to assess the degree to which they anticipate feeling regret in the event of viral transmission due to non-adherence to recommended protective measures. These items addressed four plausible situations: non-

adherence to barrier procedures, contracting the virus, infecting a close person, and infecting a less closely acquainted individuals (Cronbach's alpha = .86) (see the supplementary material for a complete list of the questionnaire items and the correlations of anticipated regret scale items).

We computed an average score for the adoption of protective behaviors by averaging the responses to the items related to health-protective behaviors, and an average score for anticipated regret by averaging the responses to the items related to anticipated regret.

## RESULTS

Two analyses of variance (ANOVA) were conducted to determine whether Age Group (adolescence vs. early adulthood vs. middle adulthood) affected (1) the adoption of health-protective behaviors and (2) anticipated regret. Both analyses revealed a significant effect of Age Group,  $F(2,410) = 40.12, p < .001, \eta_p^2 = .17$  and  $F(2, 240) = 16.65, p < .001, \eta_p^2 = .08$  respectively (see Table 1 for detailed means and standard deviations in each age group). Games-Howell post-hoc tests indicated that adolescents adopted fewer protective behaviors and reported less regret than young adults,  $ps < .001, d_{Cohen} = 0.68$  and  $d_{Cohen} = 0.33$  respectively, who also adopted fewer protective behaviors and reported less regret than middle-aged adults,  $ps < .001, d_{Cohen} = 1.17$  and  $d_{Cohen} = 0.77$  respectively.

Table 1.

*Means and standard deviations for Age, Adoption of protective behaviors and Anticipated regret in each age group.*

	Age		Adoption of protective behaviors		Anticipated regret	
	M	SD	M	SD	M	SD
<b>Adolescents (14-19 y.o.)</b>	16.85	0.85	5.88	1.43	6.50	1.99
<b>Young adults (20-29 y.o.)</b>	21.76	1.29	6.78	1.20	7.13	1.89

<b>M-A adults (30-58 y.o.)</b>	40.27	6.98	7.41	1.18	8.06	2.09
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*Note.* M-A adults = middle-aged adults

The mediation analysis performed to assess the mediating role of anticipated regret on the relationship between age and protective behaviors confirmed that age was significantly related to both the adoption of protective behaviors ( $\beta = .18, p < .001, z = 4.86$ ) and anticipated regret ( $\beta = .26, p < .001, z = 5.49$ ) (see supplementary materials). Moreover, anticipated regret acted as a mediating variable in the relationship between age and the adoption of health-protective behaviors,  $\beta = .62, p < .001, z = 16.82$ . The effect of age on adoption of protective behaviors was reduced when anticipated regret was controlled for ( $\beta = .16, p < .001$ ).

## DISCUSSION

Our findings suggest that both the adoption of health-protective behaviors aimed at preventing the spread of a virus (namely COVID-19) and anticipated regret in the event of engaging in risky health behaviors related to COVID-19 (i.e., lower adoption of the recommended protective behaviors) increase from adolescence to adulthood. These results are consistent with previous literature showing improved adaptive self-regulation for health maintenance (Brewer et al., 2016; Pența et al., 2020), as well as enhanced emotional self-regulation and greater anticipation of regret with age (Artistico et al., 2010; Feeney et al., 2018; Smerecnik and Ruiters, 2010). This finding extends prior studies highlighting that perceived risk alone is not a sufficient condition to initiate adaptive self-regulation for health maintenance; regret must also be considered in health risk-taking and in the adoption of health-related protective behaviors (Artistico et al., 2010; Brewer et al., 2016; Pasion et al., 2020; Pența et al., 2020; Ravert et al., 2021). Our findings further indicate that adolescents are capable of anticipating the regret associated with the non-adoption of recommended health-protective behaviors, which influences their decision making. Consistent with previous

studies (Dardas et al., 2020; Zhong et al., 2020), our findings suggest that adolescents are less likely than adults to adhere to pandemic-related safety protocols.

In line with previous research (Feeney et al., 2018), regret intensity is greater in adults than in adolescents. Specifically, as people age, they tend to anticipate regret more intensely, which then influences their safety decisions, and their engagement in more preventive behaviors to maintain a good health. In addition, our results support past studies indicating that greater anticipated regret from not engaging in a particular behavior is related to a stronger engagement in that behavior and to a stronger intention to engage in that behavior in the future (Brewer et al., 2016).

However, the present results differ from some previous research (Capasso et al., 2021), which found no effect of the anticipated negative affect (including regret) and cognitive attitudes on the intention to adopt a health-protective behavior against COVID-19. This difference in findings may be due to methodological variations in how negative emotions were introduced. Some authors suggest that using specific negative emotions to prevent the spread of COVID-19 may be counterproductive (Chou and Budenz, 2020). Individuals might perceive the risk as exaggerated, leading to disengagement from protective behaviors such as vaccination. In this study, participants were only asked to anticipate the regret associated with infecting others.

This study has several limitations that should to be taken into consideration in future research. In particular, these results may not be fully generalizable to other countries, especially those that have adopted different strategies to combat the COVID-19 pandemic (e.g. quarantining of cities, policy of collective immunity). In addition, our findings can only be generalized to viruses with propagation mechanisms similar to those of COVID-19. Another limitation to consider is the larger number of women than men in our sample (308 women and 102 men), as previous research suggested a significant association between male

gender and risky health behaviors related to COVID-19 (Zhong et al., 2020). Although our theoretical framework was based on the theory of planned behavior, we did not examine "attitudes" toward the virus, which may influence the relation between anticipated regret and the adoption of protective behaviors. Future studies should include this parameter in order to gain a more comprehensive understanding of the relationship between regret and health-protective behaviors.

## **CONCLUSION**

In sum, this study suggests that anticipated regret contributes to the adoption of health-protective behaviors and consequently to the reduction of health-related risk-taking – from adolescence onwards – and should therefore be considered when designing interventions to combat viral pandemics. Future research on regret related to health decisions could benefit from exploring health-protective behaviors against viruses and diseases with varying levels of health risk, from adolescence to ages beyond 60, particularly for potential use in health-behavior interventions.

**DECLARATIONS OF CONFLICTING INTEREST**

The Authors declare that there is no conflict of interest.

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