Received: 6 January 2020 | Revised: 21 June 2020 | Accepted: 24 June 2020

DOI: 10.1111/desc.13012

Developmental Science WILEY

SHORT REPORT

Voluntary pursuit of negatively valenced stimuli from childhood to early adulthood

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Funding information
This project was supported by a Harvard University startup grant to LHS and a National Institutes of Mental Health grant to KAM (R01-MH103291).

Abstract

Although common sense suggests that we are motivated to pursue positive and avoid negative experiences, previous research shows that people regularly seek out negative experiences. In the current study, we characterized this tendency from childhood to young adulthood. Due to the known increases in risky behavior and sensation seeking in adolescence, we hypothesized that adolescents would show an increased engagement with negatively valenced stimuli compared to children and adults. Participants aged 4–25 (N = 192) completed a behavioral task assessing motivation to engage with negative, positive, and neutral images. On each trial, participants viewed two small images and selected one to view at a larger size for up to 10s. Trials were organized into three valence conditions: negative versus positive images (matched on arousal), negative versus neutral images, and positive versus neutral images. Although participants chose positive images more than neutral or negative images, participants selected negative images frequently, even when given a positive (28% of trials) or neutral (42% of trials) alternative. Contrary to expectations, the tendency to choose negative images was highest in early childhood and decreased linearly with increasing age, and the tendency to choose positive images increased linearly with age. These results provide insight into how motivation to engage with emotional stimuli varies across age. It is possible that the novelty and rarity of negative experiences drives children to pursue these stimuli. Alternatively, children may find negative images less aversive, which would caution against assuming that these stimuli elicit the same motivational states in individuals of all ages.

KEYWORDS
adolescence, childhood, development, emotion, exploration, valence

1 | INTRODUCTION

Common sense holds that people strive to maximize well-being by seeking positive and avoiding negative experiences (Larsen, 2000). Indeed, processes that maintain or enhance negative affect (e.g. rumination) are associated with increased risk for multiple forms of psychopathology, including depression and anxiety (Nolen-Hoeksema, 2000; Nolen-Hoeksema, Wisco, & Lyubomirsky, 2008). However, people pursue activities that induce negative feelings, such as attending haunted attractions or watching sad movies (Kerr, Siegle, & Orsini, 2019). Research has shown that healthy people

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The data that support the findings for this study are openly available at https://osf.io/yr9wf/.

engage voluntarily with negatively valenced stimuli in the presence of positive or neutral alternatives (Oosterwijk, 2017). However, there remains an incomplete understanding of how these behaviors vary with age. The current study examines the age-related changes in the tendency to voluntarily engage with negatively valenced stimuli.

Few studies have examined the age-related changes in the tendency to seek out negatively valenced stimuli or the desire to seek out a negative affective state. In the aging literature, research shows that older adults exhibit a "positivity bias," or an age-related trend to preferentially attend to and remember positive (rather than negative) valenced stimuli (Carstensen & Mikels, 2005; Isaacowitz, Wadlinger, Goren, & Wilson, 2006). However, few studies have examined this phenomenon in youth samples. In one exception, Riediger and colleagues (2009) used experience-sampling to characterize age differences in contra-hedonic motivation (i.e. the motivation to maintain and enhance negative affect or reduce positive affect) in adolescents and adults. Throughout the day, participants indicated how much they experienced positive and negative affect and whether they wanted to "dampen," "maintain," "enhance," or "not influence at all" the emotion. Results showed that motivation to increase negative and dampen positive affect was most common in adolescence. However, little additional work characterized the tendency to seek negatively valenced stimuli or experience negative affective states in child and adolescent samples, with no studies translating this phenomenon into controlled lab environments.

Studying emotion-related behaviors in developmental samples is critical to build theories of how emotional subprocesses develop from childhood to adulthood (Somerville & McLaughlin, 2018). Previous work has shown that experiences of negative affect increase from childhood to adolescence (Larson & Ham, 1993; Larson, Moneta, Richards, & Wilson, 2002); however, the motivation to achieve negative and positive emotional states is poorly understood. If adolescents are indeed drawn to negative stimuli more than children and adults, this motivational difference could help explain age-related increases in negative affect during adolescence. In addition, studying emotional choice behavior in children and adolescents is societally relevant, as young individuals are increasingly using media autonomously and making independent decisions about what information to seek out (Twenge, Martin, & Spitzberg, 2019). Identifying the age-related changes in the motivation to engage with valenced stimuli would contribute to this broader literature.

While few studies have examined this tendency in developmental samples, numerous studies have documented the phenomenon in adults. Early investigations on voluntary negative engagement implicated sensation seeking – the motivation to seek arousing experiences – as an underlying explanation. These studies showed a positive relationship between sensation seeking and self-reported curiosity about morbid events (e.g. depictions of violence or death) (Aluja-Fabregat, 2000; Zaleski, 1984; Zuckerman & Litle, 1986). Rimé and colleagues (2005) explored emotional fascination for extremely negative scenes depicting the 9/11 attacks and found that even 8 months after the event, a majority of respondents still felt fascinated by images of the attacks. Finally, a recent study explored whether curiosity underpinned engagement with aversive stimuli (Hsee & Ruan, 2016) and found that curiosity could lead people to expose themselves to electric shocks for no apparent benefits. Together, these studies implicate sensation seeking, curiosity, and fascination as explanations for why people seek out negatively valenced stimuli in a variety of different contexts.

Additional work in adults has indicated that negative emotional experiences themselves can hold instrumental value. Research on instrumental emotion regulation (Tamir, 2009; Tamir, Mitchell, & Gross, 2008) shows that people can be motivated to increase their experience of unpleasant emotions if doing so promotes attainment of long-term goals. For example, when anticipating a threatening task, participants who judged worry as a useful emotion for avoiding threats increased their level of worry before the task (Tamir et al., 2008). Additionally, Kerr et al. (2019) examined survey data and neural reactivity associated with voluntarily engaging in high-arousal negative experiences in individuals who attended an "extreme" haunted attraction and reported subsequent positive changes in affect and decreases in global neural reactivity (as measured by electroencephalography), which the authors speculate is associated with euphoria experienced after the arousing negative experience.

In addition to these studies focusing on adult samples, most studies of this phenomenon have relied on subjective ratings to examine the desire to engage with negatively valenced stimuli or to experience a negative affective state (e.g. Riediger et al., 2009). While methods like experience sampling reflect high ecological validity, experimental approaches permit measurement of behaviors to pursue exposure to negative stimuli without availability-based confounds. Experimental methods can be particularly important in studies assessing age-related variability, as daily experiences and freedom to explore valenced material varies among this population, which could obscure findings in non-laboratory-controlled studies.

It is important to note that while some previous studies investigated the desire to experience a negative affective state (Riedeger et al., 2009; Tamir, 2009; Tamir et al., 2008), others focused on the tendency to pursue experiences with negative stimuli (Aluja-Fabregat, 2000; Hsee & Ruan, 2016; Oosterwijk, 2017; Zaleski, 1984;

Research Highlights

- The choices people make about what stimuli they engage with can radically shape their affective experiences. We examined how choices to engage with positive or negative pictures varied across ages 4–25.
- People chose to view negative stimuli even in the presence of positive or neutral alternatives, and this tendency decreased across age.
- These findings spur research on the mechanisms and implications of greater engagement with negative stimuli in children.

Zuckerman & Litle, 1986), and some explored both (Kerr et al., 2019; Rimé et al., 2005). While these two phenomena may often go hand in hand, they may not always align. The current study investigates age-related changes in the tendency to voluntarily pursue negatively-valenced stimuli from early childhood to early adulthood. To assess the tendency to engage with valenced material, we administered an affective choice task (modeled after (Oosterwijk (2017)) to a cross-sectional sample of participants spanning childhood, adolescence, and early adulthood (4–25 years). In the task, participants viewed two small images differing in valence and selected one to view at a larger size. The frequency with which participants chose to engage with negative, neutral, and positive stimuli was computed from participants' task performance and was our primary measure of interest, as in prior work (Oosterwijk, 2007). The amount of time that participants spent viewing the chosen stimulus was also calculated as a convergent measure of engagement with images in each condition.

In light of evidence that contra-hedonic motivations are elevated in adolescence compared to adults (Riediger et al., 2009), and research showing adolescent-specific increases in risk-taking behaviors and sensation seeking (Defoe, Dubas, Figner, & van Aken, 2015), we hypothesized an increase in the tendency to seek out negatively valenced stimuli in adolescence compared to young adults. While previous work examines contra-hedonic motivation in adolescence and adulthood, no work has been done examining this tendency in childhood. Therefore, while we hypothesized that adolescents would show an increased tendency to seek negative stimuli compared to adults, analyses of the childhood age range were exploratory in nature.

2 | METHODS

2.1 | Participants

Two hundred and three participants were enrolled in a broader study of emotional development (see Nook, Sasse, Lambert, McLaughlin, & Somerville, 2017; Nook, Sasse, Lambert, McLaughlin, & Somerville, 2018; Nook et al., 2019; Weissman et al., in press). Data from 11 participants were unusable and thus excluded (two did not complete the task, seven did not understand and/or cooperate with instructions, two experienced technical problems). Hence, analyses included data from 192 participants (age range = 4.13–25.91 years, M_{age} = 14.71, SD_{age} = 5.74, 50.52% female, 64.06% White, 11.46% Black/African American, 0.52% American Indian/Native Alaskan, 8.85% Asian, 0.52% Native Hawaiian/Pacific Islander, 11.98% >1 race, 1.04% other, three participants did not disclose). All participants were fluent in English and did not have cognitive impairments limiting their ability to provide consent/assent or complete tasks.

Participants were recruited from the Boston and Seattle areas. Adult participants and guardians of minor participants provided informed consent prior to participation, and minors assented to participation. All procedures were approved by the Institutional Review Boards of Harvard University and the University of Washington. Data for this study can be accessed at https://osf.io/yr9wf/.

Given the absence of published data on the development of emotional valence choice, an a priori power analysis was not possible. Hence, we ensured that the sample size was sufficiently powered to detect small-to-medium effects (i.e. $\beta > 0.20$; Cohen, 1988). A power analysis indicated that 194 participants would be required to detect an effect of this size at 80% power. A *post hoc* power analysis verified that our final sample ($N = 192$) was sufficiently powered (power = 89.7%).

2.2 | Affective choice task

All data were collected in a laboratory setting. After an informed consenting process with both the participant and parent present, participants completed the task in the testing room without their parent present in the room. Participants were shown written instructions on the screen and the experimenter read these instructions aloud to the participant (see Data S1). Before the task began, participants completed a practice session, during which the experimenter monitored participants' behavior to ensure comprehension. The experimenter answered any remaining questions they had and repeated the instructions or practice trials as needed to ensure comprehension of how to complete the task. The experimenter stayed in the room for the duration of the task for all participants. However, the experimenter sat behind the participant out of sight and worked on other tasks in order to minimize feelings of being observed.

During the affective choice task, (see Figure 1), two images (each 3.14 by 2.35) inches were presented side by side for 2s (seconds) and participants were instructed to select one image to view in a larger format (7.84 by 5.88 inches) using different keys on the keyboard. They could view the large image for up to 10s and pressed the space bar when they wanted to proceed to the next trial. A blank screen was shown for 1s between trials. The task included three choice conditions: negative versus positive images, negative versus neutral images, and positive versus neutral images. Images were selected from the International Affective Picture System database (IAPS; Lang, Bradley, & Cuthbert, 2008). There were 20 trials per condition (60 trials total) and two images per trial (120 images total). Images were selected to be valenced but appropriate for a developmental sample, with negative images depicting potentially dangerous animals, abstract references to death, distress, and violence; neutral images depicting household objects, rooms and buildings, and people in everyday scenes; and positive images depicting images such as food, nature, and friendly animals (see Data S1 for average IAPS image valence and arousal ratings). Counterbalancing was used to assign images to different choice conditions across participants so that results could not be explained by the specific images shown in that condition (see Data S1 for details).

Two dependent variables were measured from participants' task performance. *Valence choice* represented the proportion

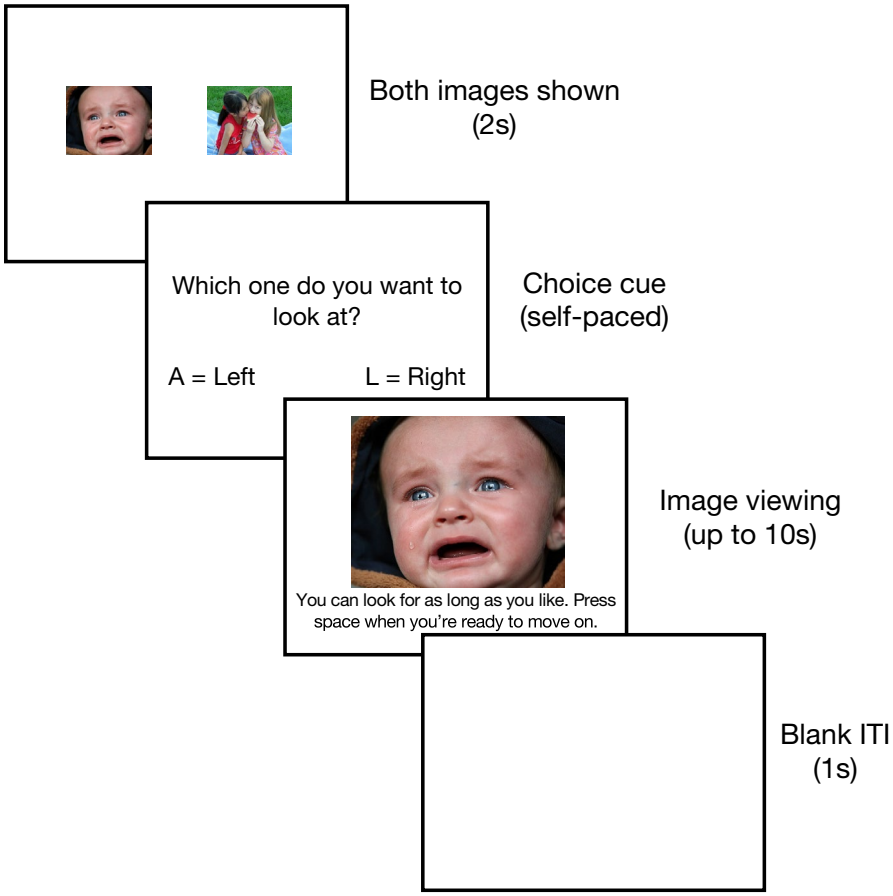

FIGURE 1 Overview of the choice paradigm. Participants viewed two small images, and indicated which they chose to view at a larger size using the "A" (left) and "L" (right) keys. They could view the larger image for up to 10 seconds. A blank screen served as the intertrial interval (ITI). Open source images for this figure were taken from the Open Affective Standardized Image Set (OASIS) and were not used in the actual experiment

of trials for which each participant chose negative, positive, or neutral images, ranging from 0% to 100% of trials for which that valence was an option. In this way, valence choice was collapsed over trial type (e.g. the proportion of negative images chosen was calculated using both negative versus neutral and negative versus positive trials). *Viewing time* represented the average amount of time (s) that participants viewed negative, positive, and neutral images after they were chosen. Viewing time averages were collapsed over trial type (e.g. viewing time for negative images was the average of time spent viewing negative images, regardless of whether the image was chosen on negative versus neutral or negative versus positive trials). Seven participants did not choose any negative images; thus, their viewing time could not be calculated, and they were excluded from viewing time analyses for negative images.

2.3 | Aims and analyses

2.3.1 | Overall valence choice

The first aim of the study was to examine whether participants voluntarily engaged with negatively valenced stimuli as in Oosterwijk (2017). To test this, we calculated the proportion of trials for which negative images were chosen in the negative versus neutral and negative versus positive conditions. One sample *t*-tests evaluated whether the percentage of trials in which negative images were chosen over positive and neutral images differed from zero.

2.3.2 | Valence choice and viewing time across age

The second aim was to identify and describe age-related changes in valence choice and subsequent viewing time of affective images. Image valence (positive, neutral, and negative) was included as an independent variable in statistical models. Age was incorporated as a predictor in the models to identify whether including age and the interaction between age and valence resulted in an improved model fit. Because age trends are not limited to linear patterns, we explored models with age modelled both linearly and non-linearly.

To explore non-linear age-related changes, we followed non-linear analytic methods similar to Rodman, Powers, and Somerville (2017) and Nook et al. (2019). This approach tests whether linear or nonlinear patterns (i.e. thin-plate smoothing spline regression models) best fit the age-related changes in the data. Thin plate regression smoothing splines are a generalized additive model approach used to produce regression equations that fit the data using cross-validation procedures but are also penalized for the number of parameters to prevent overfitting (Wood, 2003). The result of these models is a

stable, smooth curve that describes the data's age-related change but is not constrained to stereotyped linear, quadratic, or cubic shapes.

Three statistical models were conducted for each dependent variable: (a) valence as a predictor, (b) valence and valence x linear age interaction as predictors, (c) valence and valence × spline age interaction as predictors. These models were conducted for valence choice and viewing time dependent variables. However, age was not included as a main effect in the valence choice models because proportions of valence choice summed to 1 for each participant (i.e. collapsing across valence, each participant's "valence choice" value was 1, as they made a choice in 60/60 of the trials). Therefore, a main effect of age was not meaningful.

Linear analyses were tested within mixed-effects linear regression frameworks using the *lme* function in R's *nlme* package (Pinheiro, Bates, DebRoy, & Sarkar, 2019). Spline analyses were conducted using the *gamm* function using the *mgcv* package in R (Wood, 2003, 2017). The three models were then compared using Akaike Information Criterion (AIC) values. The model with the lowest AIC for each dependent variable was considered the best fit and interpreted. When significant interactions emerged, follow-up correlation analyses and *t*-tests were conducted to specify the directionality of the effects.

3 | RESULTS

3.1 | Valence choice and viewing time

Participants selected negative images for 35.3% of all trials for which a negative image was an option. Participants chose to view negative images over positive images for 28.3% (*SD* = 19.1) of trials and chose to view negative images over neutral images for 42.4% (*SD* = 23.1) of trials. Participants chose to view positive images over neutral images for 74.9% (*SD* = 13.5) of trials (Figure 2). One sample *t*-tests against zero showed that negative images were chosen in a significant percentage of trials when paired with a neutral image ($t(191) = 25.46$, $p < .001$) and when paired with a positive image ($t(191) = 20.49$, $p < .001$).

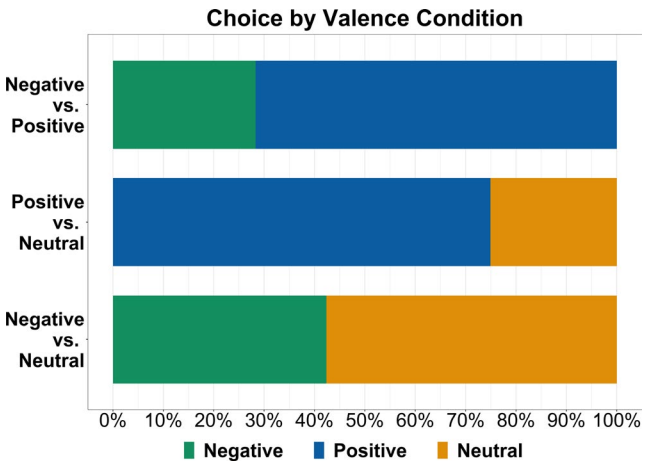

FIGURE 2 Percentage of trials that negative, neutral, and positive images were chosen in each condition: negative versus positive, positive versus neutral, negative versus neutral

3.2 | Valence choice and viewing time across age

Results are summarized in Table 1. For both valence choice and viewing time, the valence x linear age model produced the best fitting model compared to the valence only model and the valence x spline age model; thus, the linear models were selected for inference. We present mixed-effect model statistics within the context of an analysis of variance test for ease of interpretation of the main effect of valence, which has 3 levels. For the valence choice measure, we found a main effect of valence ($F(2, 379) = 336.33$, $p < .001$) and a significant interaction between valence and age ($F(3, 379) = 5.36$, $p = .001$) (Figure 3). Post-hoc pairwise *t*-tests showed

TABLE 1 Results of null, linear, and thin plate smoothing spline models for each dependent variable

Dependent variable	Model	AIC
Valence choice	Linear (valence only)	−966.23
	Linear (valence × age)	**−976.24**
	Spline (valence × age)	−975.95
Viewing time	Linear (valence only)	1,801.20
	Linear (valence × age)	**1,785.03**
	Spline (valence × age)	1,787.18

Note:: Bold text indicates best fitting model for each dependent variable, as determined by AIC.

Abbreviation: AIC, Akaike Information Criterion.

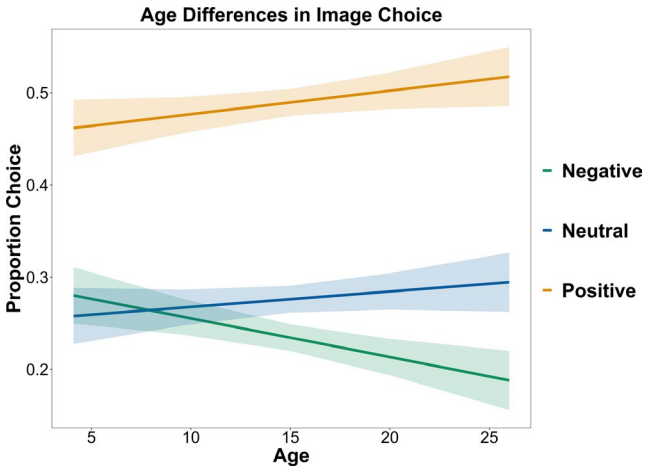

FIGURE 3 Proportion of trials that positive (gold), neutral (blue), and negative (green) images were chosen across age. Proportions reflect choice of positive, neutral, or negative images collapsed across condition. Solid colored lines depict linear model fits. Shaded regions depict standard errors

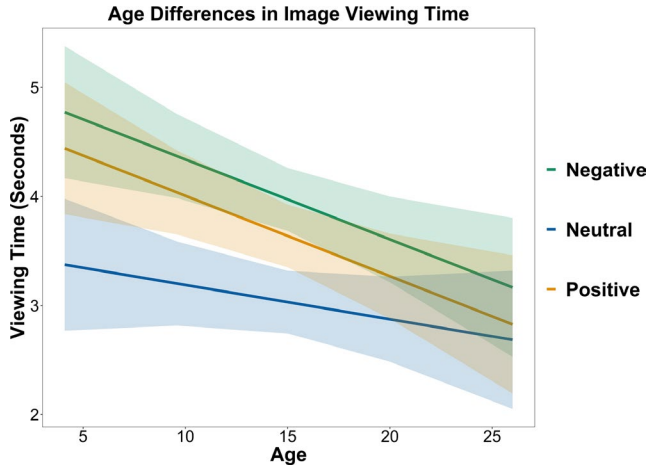

FIGURE 4 Image viewing time for positive (gold), neutral (blue), and negative (green) images across age. Maximum viewing time for each image was 10s. Solid colored lines depict linear model fits. Shaded regions depict standard errors

that overall, valence choice for positive images was significantly higher than choice for negative ($t(191) = -16.65$, $p < .001$) and neutral ($t(191) = 25.63$, $p < .001$) images, and valence choice for neutral images was significantly higher than choice for negative images ($t(191) = -2.79$, $p = .006$). Follow-up tests to specify the direction of the valence × age interaction indicated that with increasing age, choice for negative images decreased ($r(190) = -.18$, $p = .01$), choice for positive images increased ($r(190) = .16$, $p = .03$), and choice for neutral images was unrelated to age ($r(190) = .12$, $p = .11$).

For the viewing time dependent variable, we found a significant main effect of age ($F(1, 190) = 5.92$, $p = .016$), a main effect of valence ($F(2, 373) = 99.77$, $p < .001$), and a significant interaction between valence and age ($F(2, 373) = 8.32$, $p < .001$) (Figure 4). Seven participants did not choose any negative images and therefore were omitted from analyses of viewing time for negative images. Post-hoc pairwise *t*-tests showed that overall, viewing time for negative images was significantly longer than viewing time for neutral ($t(184) = 11.99$, $p < .001$) and positive images ($t(184) = 5.04$, $p < .001$), and viewing time for positive images was significantly longer than viewing time for neutral images ($t(191) = 9.61$, $p < .001$). Follow-up tests to specify the direction of the valence x age interaction indicated that with increasing age, viewing time for negative images decreased ($r(183) = -.19$, $p = .01$), viewing time for positive images decreased ($r(190) = -.19$, $p = .01$), and viewing time for neutral images did not significantly correlate with age ($r(190) = -.10$, $p = .18$). Additional follow-up analyses of choice behavior based on image content can be found in the Data S1.

4 | DISCUSSION

This study assessed the tendency to seek out positively and negatively valenced stimuli from childhood to adulthood. Overall, participants chose to view positive images more frequently than neutral or negative images. However, participants also selected negative images even when given a positive (28% of trials) or neutral (42% of trials) alternative. This tendency to choose negative images decreased across age, while the tendency to choose positive images increased with age. Once an image was chosen, the time spent viewing positive and negative images decreased with age. Therefore, contrary to our hypothesis, children exhibited the greatest tendency to voluntarily choose negative stimuli and view them for longer durations.

The observed tendency to pursue negative images counters the assumption that people consistently avoid aversive stimuli. This finding is consistent with work in an adult sample showing that people chose to view images that portrayed death, violence or harm (Oosterwijk, 2017). More broadly, this finding aligns with several previous studies, each showing with different approaches that people chose to expose themselves to negatively valenced stimuli (e.g. Kerr et al., 2019; Riediger et al., 2009).

In addition to documenting the overall tendency to seek out negatively valenced stimuli, we characterized age-related changes of this behavioral tendency in a sample ranging in age from 4–25 years. Results showed that young children were most likely to choose negatively valenced images (such as those displaying references to death, violence, dangerous animals, and other negative scenes), and this tendency decreased linearly with age. The opposite trend was observed for positively valenced images (such as those displaying references to food, nature, and friendly animals), such that young children were least likely to choose positive images, and this tendency increased linearly with age.

An elevated tendency to seek out negative cues in adolescents relative to adults is consistent with previous work showing a decrease in the desire to maintain or enhance negative affect from age 14 to young adulthood (Riediger et al., 2009). Although these lines of data both document age-related decreases in pursuit of negative stimuli, the experimental design and age range differs greatly (i.e. laboratory task in sample 4–25 years for the current study and experience sampling design in 14–86 years for Riediger et al., 2009). Because Riediger and colleagues did not examine younger children, our finding that children show an even greater tendency to seek negative stimuli than adolescents and adults cannot be compared to this previous study. Future work is needed to knit these lines of evidence together by testing whether children exhibit an elevated tendency to seek out negative experiences in their daily lives.

The current study aimed to evaluate the tendency to seek out negatively valenced stimuli and to characterize the age-related changes in this tendency. This descriptive approach represents a necessary first step toward understanding the phenomenon at hand, although our ability to provide causal explanations for why this tendency changes across age is limited at this stage of scientific inquiry. However, by discussing relevant literature we hope to offer hypotheses concerning mechanisms that we hope will motivate future research.

One account for the observed phenomenon is sensation seeking theory (Zuckerman, 1979; Zuckerman & Litle, 1986), which suggests

that individual differences in the need for novel and arousing experience leads to the motivation to seek "sensational" events. According to a sensation-seeking account, children would choose negative images more than older participants because of an increased desire for the arousal or intense sensations they provoke. However, previous longitudinal research provides evidence that self-reported sensation seeking increases linearly with age (9 to 18 years; Collado, Felton, MacPherson, & Lejuez, 2014) rather than decreases, making this account unlikely.

Another account for this phenomenon is that negatively valenced stimuli are particularly effective at capturing or engaging attention. Previous studies have shown support for this possibility using the dot probe paradigm, a spatial attention task used to assess attentional bias toward emotional cues. Studies using the dot-probe paradigm show that individuals exhibit an attentional bias toward threat-related cues (e.g. van Rooijen, Ploeger, & Kret, 2017 for review). This raises the possibility that children are especially susceptible to the attentional pull of the negative stimuli. However, a different study of the current sample examining attention bias to emotion (Jenness et al. under review) finds no age-related differences in attention bias to threatening stimuli. This result provides evidence against the explanation of attentional capture processes explaining the observed age-related differences.

A third explanation for the phenomenon is that negative stimuli offer more novelty than positive or neutral stimuli, in that they are more rarely encountered in an individual's environment. Novelty is associated with a curiosity to fill gaps in knowledge and a motivation to explore and learn about new environments (Silvia, 2012). Somerville and Whalen (2006) showed in a large sample of undergraduates that negative emotional expressions (i.e. sadness, anger, disgust, and fear) were ranked as being encountered less frequently as compared to positive (happiness) and neutral expressions in daily life. Negative stimuli in the current study - that evoke themes such as death and violence – are similarly likely to be encountered infrequently in participants' daily life. These relatively novel stimuli may therefore provoke an increase in curiosity and motivation to pursue the negative material. As these scenes (e.g. death, violence) are likely to be encountered less in a child's environment than environments of adolescents and adults, this could elicit greater curiosity and engagement with negative stimuli for younger children that remits with greater life experience. Future studies are needed to test whether novelty effects do indeed explain elevated pursuit of negative stimuli in childhood.

In addition to the three accounts described above, various other factors may be relevant in explaining the age-related findings. For example, pressures of social norms and social desirability may influence younger participants differently than older participants. Young children may not perceive that choosing to engage with negative stimuli is socially unusual (and potentially less acceptable), whereas adolescents and adults may have greater awareness of social conventions. Additionally, while the current study was limited in its ability to investigate individual differences, prior work suggests differences in personality and temperament that emerge early in life may help account for the observed choice behavior (e.g. Kagan, 2003; LoBue & Pérez-Edgar, 2014). This work highlights important areas for future study.

In addition to age-related changes in image choice, we observed parallel age effects on subsequent image viewing time. Although viewing time for neutral stimuli did not change significantly across age, younger participants viewed both negatively and positively valenced images for longer durations than older participants. The duration of time spent viewing a chosen image may reflect several underlying processes including interest and engagement, attentional vigilance, or difficulty disengaging. Alternatively, the novelty account may explain viewing time durations, such that longer viewing times allow children to more fully encode images that are relatively unfamiliar to them compared to adults.

In future work, it will be critical to identify the subject affective experience generated by positive and negatively rated stimuli. The images used in the present study were selected from the IAPS set based on normative rating data acquired from adults (Lang et al., 2008). We obtained valence and arousal rating data on a similar set of IAPS images in a separate sample of children, which showed strong correspondence with the adult normative ratings (see Data S1). Thus, while there is reason to believe that older and younger participants experienced these images as similarly valenced, we cannot rule out the possibility that children assigned less negative (or even positive) valence to them, relative to older individuals. Nonetheless, regardless of the affective experience evoked, future research using valenced images should not assume that children and adults are similarly motivated to avoid negatively valenced stimuli.

Three additional limitations of the current work should be addressed. First, the cross-sectional design used limits the strength of inferences that can be made on developmental processes underlying the observed tendency to seek out negatively valenced stimuli. A longitudinal design would be needed to elucidate the changes in this behavior over time. Second, because our analyses focused on image content, we did not assess how different qualities of the images such as color and complexity affected choice behavior. While we do not have reason to suspect that these qualities influenced choice behavior differently across different valence conditions or age, this should be explicitly quantified and tested in future studies. Third, we cannot assess the generalizability of our findings to other types of laboratory tasks or to real-world emotional decision making. The current study relies on a two-choice decision task, which may not reflect how individuals choose to engage with emotional stimuli in their daily lives. Research using eye-tracking methods raises the concern that there may be low correspondence between constrained and unconstrained tasks in adults (Isaacowitz, Livingstone, Harris, & Marcotte, 2015) and between computer-based tasks and mobile eye-tracking measures in children (Fu & Pérez-Edgar, 2019). In addition, the images used in this study are static, mild, and lack personal relevance in comparison to typical negative and positive events of real life. Future research should explore whether the

current results generalize to different tasks designs, including unconstrained choice tasks, tasks with stimuli that elicit stronger and more authentic emotional experiences, and naturalistic study designs that assess emotional experiences in individuals' daily lives.

5 | CONCLUSION

This study characterized age-related changes in the tendency to seek out negatively valenced stimuli in a two-choice laboratory task. Results showed that people chose to view negative stimuli even in the presence of positive or neutral alternatives, and this tendency to engage with negative material decreased across age from childhood to adulthood. These findings contribute to a refined account of emotional development that considers age-related changes in the motivation to pursue and remain engaged with valenced stimuli.

ACKNOWLEDGMENTS

The authors thank China Rose Marie Bolden, Aridenne Dews, Eliot Fearey, Megan Garrad, Tierra Gogue-Garcia, Kevin Kent, Alka Sareen, Manna Sirak, Taylor Stacy, and Christina Uhrig for assistance with data collection. The authors also thank Thomas Rusch for guidance on data analysis.

CONFLICT OF INTEREST

The authors declare no conflicts of interest.

AUTHOR CONTRIBUTIONS

ECN, SFS, HKL, KAM, and LHS developed the study design. ECN, SFS, and HKL collected behavioral data. KAG, SFS, ECN, and LHS designed analytic plan and analyzed data. KAG, SFS, ECN, and LHS interpreted results. KAG and LHS drafted the manuscript, and all other authors provided critical revisions. All authors approved the final version of the manuscript for submission.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section.

How to cite this article: Grisanzio KA, Sasse SF, Nook EC, Lambert HK, McLaughlin KA, Somerville LH. Voluntary pursuit of negatively valenced stimuli from childhood to early adulthood. *Dev Sci*. 2021;24:e13012. https://doi.org/10.1111/desc.13012