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Happier, faster: Developmental changes in the effects of mood and novelty on responses

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Positive mood ameliorates several cognitive processes: It can enhance cognitive control, increase flexibility, and promote variety seeking in decision making. These effects of positive mood have been suggested to depend on frontostriatal dopamine, which is also associated with the detection of novelty. This suggests that positive mood could also affect novelty detection. In the present study, children and adults saw either a happy or a neutral movie to induce a positive or neutral mood. After that, they were shown novel and familiar images. On some trials a beep was presented over headphones either at the same time as the image or at a 200-ms stimulus onset asynchrony (SOA), and the task of the participant was to detect these auditory targets. Children were slower in responding than adults. Positive mood, however, speeded responses, especially in children, and induced facilitatory effects of novelty. These effects were consistent with increased arousal. Although effects of novelty were more consistent with an attentional response, in children who had watched a happy movie the novel images evoked a more liberal response criterion, suggestive of increased arousal. This suggests that mood and novelty may affect response behaviour stronger in children than in adults.

Keywords: Novelty; Mood; Response times; Developmental psychology; Affect; Facilitation.

The brain is tuned towards new things in the environment: Novel information often automatically attracts attention (Knight, 1996) and sometimes elicits an overt behavioural response known as the orienting response (Sokolov, 1963). This response is believed to be crucial for many species in order to explore the environment and adapt to present demands (Panksepp, 1998).

Such orienting behaviour can have detrimental as well as beneficial effects on task performance (SanMiguel, Morgan, Klein, Linden, & Escera, 2010; Wetzel, Widmann, & Schroger, 2012). On the one hand, the task-irrelevant novel stimulus may distract observers from tasks they perform because they orient towards the stimulus and thus away from the task. On the other, a novel stimulus may facilitate task performance. Novel stimuli can

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do this either by acting as a warning signal eliciting a general alerting response (Aston-Jones & Cohen, 2005; Bernstein, Chu, Briggs, & Schurman, 1973; Hackley & Valle-Inclan, 1998; Nieuwenhuis, Aston-Jones, & Cohen, 2005; Schomaker & Meeter, 2014; Wetzel et al., 2012), or by recruiting attention (Schomaker & Meeter, 2012). The first, general alerting, leads to an increase in arousal and will typically result in speeded responses, a shift towards a more liberal response criterion, and the same or reduced accuracy. The second, an increase in attention, may result in faster responses and will typically result in increased accuracy (Posner, 1978). Some have suggested that both distracting and facilitating effects are the result of the same process (Näätänen, 1992; SanMiguel, Linden, & Escera, 2010; Wetzel et al., 2012). Whether facilitation or distraction will occur then depends on several factors, such as task demands (SanMiguel, Linden, et al., 2010), informational value (Parmentier, Elsley, & Ljungberg, 2010; Wetzel, Schroger, & Widmann, 2013; Wetzel et al., 2012), and stimulus characteristics (Schomaker & Meeter, 2014). Facilitation typically only occurs when attentional demands are low, standard stimuli setting the stimulus context are simple, and novel stimuli are deviant as a category, while distraction typically occurs when the attentional demands are high, and the novel stimuli provide task-relevant information (Wetzel et al., 2012).

Observer variables may also affect novelty processing and its subsequent effects on behaviour. In particular, several studies have reported age-related differences in responses to novelty. Novel stimuli elicit a novelty P3, an event-related potential (ERP) component believed to be the physiological manifestation of the orienting response or the evaluation of novelty (Friedman, Cycowicz, & Gaeta, 2001; Friedman, Goldman, Stern, & Brown, 2009). The novelty P3 has a more frontal and more generalized distribution in children, and a more central scalp orientation in adults (Maatta et al., 2005) and adolescents (Brinkman & Stauder, 2008; Wetzel & Schroger, 2007). The more anterior novelty P3 in children might be due to stronger frontal lobe involvement. The frontal lobe is a region where myelination continues well into the second decade of life (Klingberg, Vaidya, Gabrieli, Moseley, & Hedehus, 1999). In general, myelination is associated with processing speed (Brouwer et al., 2012), and therefore children can be expected to respond more slowly than young adults. Higher involvement of frontal brain regions in novelty processing has been suggested to reflect increased distraction in children (Wetzel & Schroger, 2007). Thus, the way the brain processes novelty changes with age. However, no previous studies have investigated the effects of novelty on behaviour in children compared to adults.

One other factor possibly affecting performance on a reaction time task is mood or affect. Recently, induced sadness was shown to increase distraction (i.e., slow response times) by unexpected deviant sounds in a visual categorization task (Pacheco-Unguetti, & Parmentier, 2014). Positive mood, on the other hand, has been shown to affect performance on cognitive tasks: It enhances cognitive control in an antisaccade test (Van der Stigchel, Imants, & Ridderinkhof, 2011), increases flexibility and evaluative control (van Wouwe, Wylie, Band, van den Wildenberg, & Ridderinkhof, 2010), and leads to variety seeking in decision making (Kahn & Isen, 1993); however, such benefits may occur at the cost of distraction (Aarts, van Holstein, & Cools, 2011; Dreisbach & Goschke, 2004). Transient boosts in frontostriatal dopamine have been suggested to underlie the beneficial effects of positive affect on reward-based learning (Ridderinkhof et al., 2012). Interestingly, also detection of novelty has been suggested to depend on dopamine (Heitland, Kenemans, Oosting, Baas, & Bocker, 2013; Lisman, & Grace, 2005; Rangel-Gomez, Hickey, & Meeter, 2012).

Under certain conditions, novelty and positive mood can thus both lead to enhanced performance, and both are thought to rely on the same dopaminergic responses for part or all of their effects. Via their effects on dopamine, mood and novelty may interact in facilitating responses: Positive mood may promote novelty processing, thereby strengthening novelty's facilitatory effects. Such an effect of mood on novelty is suggested by the broaden-and-build theory, which proposes that positive emotions can stimulate exploratory behaviour (Fredrickson, 2004). In line with this theory, people are more inclined to switch from buying one product to another when they are in a happy mood (Kahn & Isen, 1993). In addition, positive mood as induced by humorous movies increases sympathetic arousal (Lackner, Weiss, Hinghofer-Szalkay, & Papousek, 2013). Positive mood may thus affect task performance by increasing arousal.

In the present Experiment 1, a large sample of children and adults were tested on an auditory target detection task while complex novel and familiar (standard) fractal images were presented in order to obtain a developmental perspective on the effects of novelty on responses. This task is an adaptation of a task used by Schomaker and Meeter (2012), in which novel fractals, seen just once in an experiment, were shown to lead to better perception of a faint visual target presented afterwards than familiar fractals seen many times. Here, we looked at whether novel stimuli would also yield to faster detection of auditory targets, and whether these effects would interact with mood and age. To manipulate mood, half of the participants watched a neutral and the other half a happy movie before performing the task. As effects of the movies on mood were not apparent at the end of the task, we performed a second experiment to confirm that the movies did in fact affect mood, even though these effects washed out during performance of experimental tasks.

After the start of the current project, we found that novel fractals do not yield faster target detection than familiar fractals (Schomaker & Meeter, 2014). Although in the present study, no novelty-induced response facilitation could thus be expected in adults, it was still possible that positive affect and novelty would interact in affecting task performance, and that either or both factors would interact with age. To preview results, this was exactly what we found in children. Our expectations were that children would perform worse than adults and that positive mood would enhance performance and induce facilitatory effects of novelty.

EXPERIMENT 1

Method

Participants

A total of 173 volunteers (age 6–70 years, mean = 27.8, *SD* = 16.5) with normal or corrected-to-normal vision completed the task in the present study. Participants received a small token (a poster) as a reward for their participation. Six participants decided to quit the experiment and were excluded from the analyses. Of the included participants ($n = 167$), 62 were children (age ≤ 17 years; mean age = 12.01 years; 25 female; *n* in happy group = 33), and 105 were adults (age ≥ 18; mean age = 37.18 years; 52 female; *n* in happy group = 53). All participants were visitors of the NEMO Science Center in Amsterdam, the Netherlands. The lack of balance in the size of the age groups was the result of the age distribution of the visitors of the NEMO Science Center, which could not be forecasted in advance. Prior to the experiment, 86 participants saw a neutral and 81 a happy movie clip. Participants with an even subject number saw the neutral, and participants with an uneven subject number saw the happy movie. Seven participants did not fill out one of two mood ratings. The project was part of the Science Live Program (see http://www.sciencelive.nl/) and received ethical approval from the ethics committee of the Faculty of Psychology and Education of the VU University Amsterdam.

Stimuli and apparatus

In the present study we used 270 fractal images, pictures produced by iterative mathematical computations using the open-source program ChaosPro 4.0 (http://chaospro.de). The fractals are not semantically meaningful and had never been experienced before by the participants (the same stimuli were used by Schomaker & Meeter, 2012). The fractals covered a visual angle of about 24 × 18° on the laptop screen. One fractal image, randomly drawn from the pool, acted as a standard stimulus. All other stimuli were novel fractals, presented only once throughout the experiment. The auditory target was a 50-ms beep consisting of a 1000-Hz pure tone, presented through sound-attenuating headphones. The sound was presented over headphones that differed in quality, and therefore the intensity of the sound probably varied between participants. We checked each day that the sound was clearly audible but not too intense, resulting in different settings per laptop. A response was given by a button-press on a serial response box.

Design and procedure

Figure 1A shows the experimental design. Participants were seated in a sound-attenuated room with the atmosphere of a living room. Before the start of the experiment, participants, or in the case of minors, parents/guardians, signed informed consent. Participants indicated their mood state on a Visual Analogue Scale (VAS) on a scale of 0–100. The experimental stimuli were presented on a laptop (1024 × 768 pixels, 60-Hz refresh rate) at a viewing distance of about 30–40 cm. Before the start of the task, participants

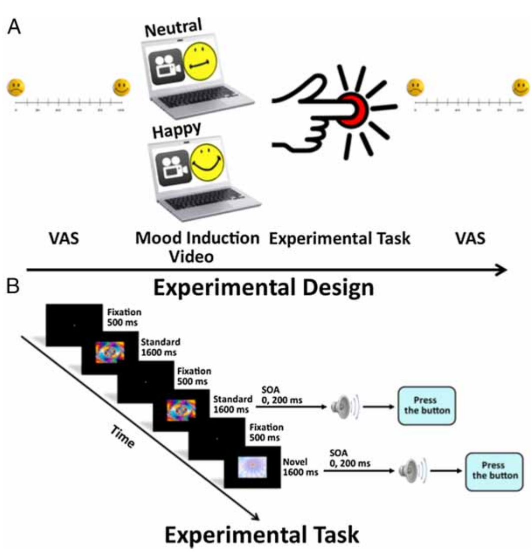

Figure 1. *Design and task of Experiment 1. (A) Participants first filled in a Visual Analogue Scale (VAS) to indicate their happiness. Next they watched a happy or neutral movie. Then they performed the experimental task, after which they again filled in the VAS. (B) Example stimulus sequence. To view this figure in colour, please visit the online version of this Journal.*

viewed either a neutral (a person mowing the lawn) or a happy (a laughing baby) mood induction movie of one-minute duration. The subsequent task was an auditory detection task, in which participants also passively viewed a sequence of stimuli. Figure 1B shows an example stimulus sequence from the experimental task. In a short practice block of nine trials, the auditory target was presented three times in order to ascertain that the participant understood the task. In total, participants performed 240 trials of the main task with a break after every 40 trials. In this self-paced break, participants received feedback on their accuracy and response times, with respect to previous blocks. A block had a duration of about 2 minutes.

A trial started with a fixation point in the form of the iris of an eye presented for 500 ms in the middle of the screen, followed by a visual stimulus. The visual stimulus could be of two kinds: on 50% of all trials, a repeated standard stimulus (a fractal), and on the other 50% of all trials an unrepeated unique fractal (the novels), randomly drawn from a set of 270 fractals. An auditory target, a beep, was presented on 20% of all trials with equiprobability to occur together with a novel or standard image. This target required a speeded response, which could be made by the index finger of the preferred hand. The beep was presented at one of two stimulus onset asynchronies (SOAs; 0 or 200 ms) after the onset of the visual stimulus. The visual stimulus stayed on the screen until the auditory target was presented and for an additional 1600 ms. After presentation of the auditory target, feedback was presented on the screen. In case of a correct, a too late, or no response within 1600 ms, the text “Correct”, or “Here, a response was required” was shown for 500 ms.

After finishing the task, participants rated 10 figures on their novelty as a pilot for other studies, and adults then completed the Novelty Seeking scale of the Tridimensional Personality Questionnaire (Cloninger, 1987; Cloninger, Przybeck, & Svrakic, 1991). No correlations between personality and behaviour were found, and we do not report on the ratings or these personality measures. Finally, participants again rated their mood on the VAS. The entire session lasted about 15–18 minutes.

Statistical analyses

First participants were divided in three age groups: children 6–12 years, children 13–17 years, and adults age 18 years and up, but since the children were not differently affected by the experimental conditions, they were taken together in the analyses (see below). Response times were investigated with a repeated measures 2 × 2 × (2 × 2) analysis of variance (ANOVA) with stimulus (novel, standard), and SOA (0 ms, 200 ms) as within-subjects factors and age (children, adults), and mood (happy, neutral) as between-subjects factors. Three-way interactions with mood were further investigated with 2 × 2 × 2 ANOVAs. All main effects, but only significant interactions, are reported. Accuracy was defined by $d' = Z$(hit rate) − Z(false-alarm rate). Also response bias, $\beta = -[Z(\text{hit rate}) + Z(\text{false alarm rate})]/2$, was calculated. Accuracy and response bias were subjected to the same ANOVA as that used for response times. Mood was investigated by comparing the pre- and posttest scores on the VAS with a paired-samples *t* test. In addition, mood change as measured by the difference of the posttest minus the pretest was compared between mood groups with an independent-samples *t* test.

Results

The pre- and posttest mood ratings did not differ (pretest mean = 74.1, SD = 13.4; posttest mean = 73.1, SD = 13.4), $t(159) = 1.27$, $p = .204$, and this difference did not differ for the two mood groups (“happy” group mean = 0.1, SD = 13.2; neutral group = 2.25, SD = 11.0), $t(158) = 1.12$, $p = .263$.

Response times

Children age 6–12 years and children 13–17 years were compared: Younger children were generally slower than the older children, as evidenced by a negative linear correlation between age and response times, $r^2 = -.458$, $p < .001$, and by slower responses for younger than for older children, $F(1, 63) = 24.92$, $p < .001$, $\eta^2 = .28$; however, no other differences between the age groups were found (interactions with age group $p > .171$). Since the effects caused by the experimental manipulation were not different for the younger and older children, these age groups were taken together for the rest of the analyses.

Figure 2 shows average response times, accuracy, and response bias for novel and standard stimuli at both SOAs for children and adults for both mood groups for both conditions. Response times were not affected by stimulus type or SOA ($F < 1$). Age group had a main effect, with adults responding faster than children, $F(1, 163) = 31.23$, $p < .001$, $\eta^2 = .16$. Also mood affected response times, with faster responses in the “happy” than in the neutral group, $F(1, 163) = 5.29$, $p = .023$, $\eta^2 = .03$. Mood and age interacted, $F(1, 163) = 4.64$, $p = .033$, $\eta^2 = .03$: children in the “happy” group were faster, $F(1, 60) = 5.74$, $p = .020$, $\eta^2 = .09$, than those in the neutral group , while adults were not affected by mood ($F < 1$). Thus, the main effect of mood was driven by the effects in children. In addition, stimulus, mood, and age interacted, $F(1, 163) = 4.26$, $p = .041$, $\eta^2 = .03$. This interaction was further investigated with a 2 × 2 × 2 ANOVA per stimulus type. Mood and age interacted for novel stimuli, $F(1, 163) = 5.92$, $p = .016$, $\eta^2 = .04$. Additional follow-up tests showed that children in the “happy” group were faster after presentation of a novel image than children in the neutral group, $F(1, 60) = 6.88$, $p = .011$, $\eta^2 = .10$, whereas adults did not show an effect of mood ($p = .950$). This effect was weaker for standard images, $F(1, 163) = 3.31$, $p = .071$, $\eta^2 = .02$, but follow-up tests showed that children were also faster in the happy than in the neutral group for standard images, $F(1, 60) = 4.48$, $p = .039$, $\eta^2 = .07$, while adults did not show an effect of mood ($p = .736$). No other interactions were significant ($p > .117$).

Accuracy

There was no main effect of stimulus on accuracy, $F(1, 163) = 1.48$, $p = .226$, $\eta^2 = .01$. SOA did affect accuracy, $F(1, 163) = 18.25$, $p < .001$, $\eta^2 = .10$, with higher accuracy at the 200-ms than at the 0-ms SOA. Accuracy was higher in the

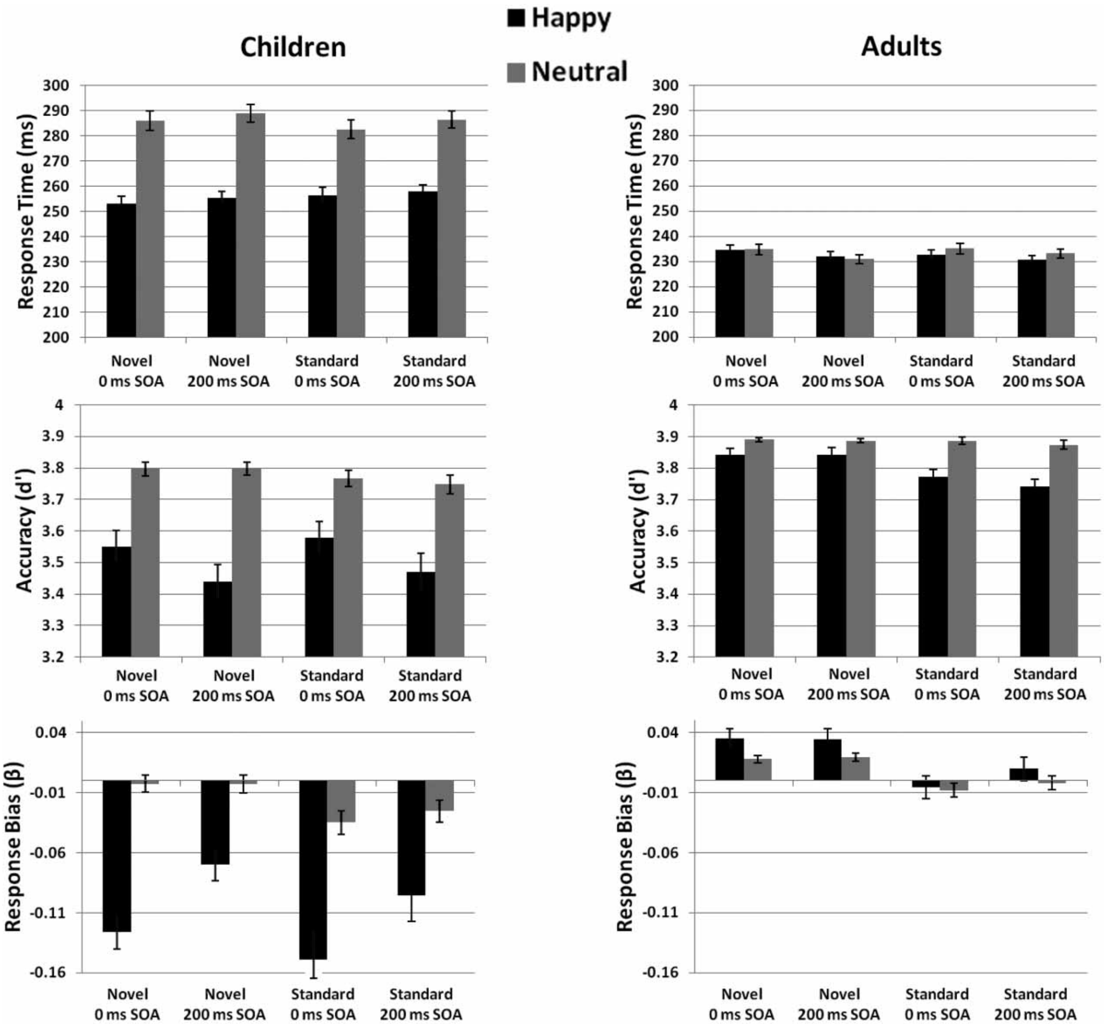

Figure 2. *Task performance in Experiment 1 for children and adults in the happy and the neutral groups. Average response times (in ms), accuracy (as d′), response bias (as β—a negative β reflects a more liberal and a positive β a more conservative criterion) for novel and standard stimuli at the 0- and 200-ms stimulus onset asynchrony (SOA). Error bars reflect one standard error of the mean. To view this figure in colour, please visit the online version of this Journal.*

neutral group than in the "happy" group, $F(1, 163) = 5.73$, $p = .018$, $\eta^2 = .03$, and higher for adults than for children, $F(1, 163) = 7.42$, $p = .008$, $\eta^2 = .04$. SOA and mood interacted, $F(1, 163) = 10.49$, $p = .001$, $\eta^2 = .06$, as did SOA and age, $F(1, 163) = 8.41$, $p = .004$, $\eta^2 = .05$, and all three factors, SOA, age, and mood, $F(1, 163) = 7.89$, $p = .006$, $\eta^2 = .05$. This three-way interaction was further investigated per mood group. In the "happy" group, children had lower accuracy than adults, especially at the 200-ms SOA, $F(1, 79) = 11.12$, $p = .001$, $\eta^2 = .12$. No interaction of SOA and age was found in the neutral group ($F < 1$), suggesting that the three-way interaction was driven by the effects in the "happy" group. There was a trend for an interaction between stimulus, mood, and age, $F(1, 163) = 2.88$, $p = .092$, $\eta^2 = .02$, consistent with lower accuracy for novel stimuli specifically for children in the "happy" group. No other interactions were found for accuracy ($p > .321$).

Response bias

During the presentation of novel stimuli, participants adopted a more conservative response criterion (fewer hits and/or fewer false alarms) than during the presentation of standards, $F(1, 163) = 4.38$, $p = .038$, $\eta^2 = .03$. At the 200-ms SOA, the response bias was more conservative than at the 0-ms SOA, $F(1, 163) = 18.25$, $p < .001$, $\eta^2 = .10$. Response bias did not differ between the two mood groups, $F(163) = 2.59$, $p = .110$, $\eta^2 = .02$. Adults adopted a more conservative criterion than children, $F(1, 163) = 8.84$, $p = .003$, $\eta^2 = .05$.

Age and mood interacted, $F(1, 163) = 4.25$, $p = .041$, $\eta^2 = .03$, with children in the "happy" condition adopting a more liberal response criterion than children in the neutral condition, while no such effect was found for adults. In addition, age and SOA interacted, $F(1, 163) = 8.41$, $p = .004$, $\eta^2 = .05$, as did SOA and mood, $F(1, 163) = 10.49$, $p = .001$, $\eta^2 = .06$, and SOA, mood, and age, $F(1, 163) = 7.89$, $p = .006$, $\eta^2 = .05$. The last three-way interaction was further investigated per mood group. In the "happy" group, for children the response bias was more liberal at the 0-ms SOA than at the 200-ms SOA, whereas it was similar at both SOAs for adults, $F(1, 79) = 11.12$, $p = .001$, $\eta^2 = .12$. SOA and age did not interact for the neutral group ($F < 1$), which suggests that the interaction SOA and age was mainly driven by the effects in the "happy" group. The other factors did not affect the response criterion ($p > .321$).

Discussion

The results presented above suggest that our mood manipulation affected performance of both adults and children. Paradoxically, this occurred even though no effect of the movies on mood was detected at the end of the experiment. One reason for this pattern of results may be that mood induction was successful, but that this effect had worn off by the end of the test when mood was assessed. To test this explanation, we performed a control experiment in a college student population, in which mood was assessed before showing the movies of Experiment 1, and after it. Mood was assessed a third time after an unrelated experimental task was performed, with the expectation that any mood-inducing effect of the movie would be apparent immediately after showing the movie, but not at the end of the experimental task. Discussion of the other results of Experiment 1 is postponed until after presentation of Experiment 2.

EXPERIMENT 2

Method

Sixty students of VU University Amsterdam (mean age 21.6 years, range 16–29 years, 41 females) participated for course credit or monetary remuneration (€8 per hour). As in the first experiment, participants first rated their mood on the same visual analogue scale (VAS) as that used in Experiment 1. They then viewed one of the two movies also used in Experiment 1. Unlike in Experiment 1, participants rated their mood again on the VAS immediately after viewing the movie. They then performed unrelated visual search tasks based on Meeter and Olivers (2006), which lasted between 25 and 40 min. After this task, they again rated their mood with the VAS. Due to a programming error, 36 students saw the happy movie, and 24 students the neutral movie.

Results and discussion

Figure 3 shows mood ratings for the two conditions at the start of the experiment, after viewing the movie, and at the end of the experiment. A 2 × 3 mixed ANOVA was used with as between-subject factor mood (happy vs. neutral) and as within-subject factor moment (start, after movie, end). To correct for a violation of the assumption of sphericity, degrees of freedom were adjusted with the Greenhouse–Geisser correction. Both

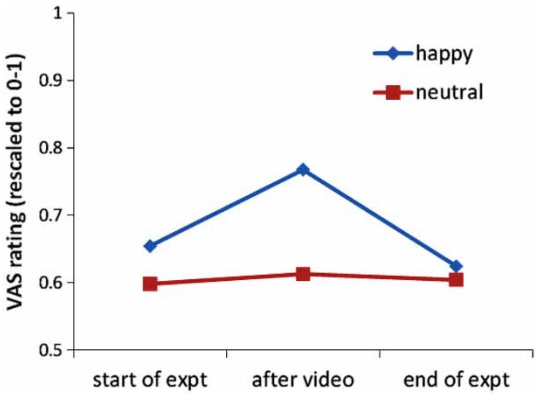

Figure 3. *Mood ratings in Experiment 2, measured at the start of the experiment, immediately after viewing the movie, and 25–40 min later at the end of an unrelated task. VAS = Visual Analogue Scale. To view this figure in colour, please visit the online version of this Journal.*

mood, $F(1, 58) = 8.02$, $p = .006$, $\eta^2 = .121$, and moment, $F(1.68, 97.46) = 18.23$, $p < .001$, $\eta^2 = .239$, had a main effect on VAS ratings, and both factors interacted, $F(1.68, 97.46) = 13.25$, $p < .001$, $\eta^2 = .186$. Post hoc contrasts showed that this interaction followed a quadratic pattern, $F(1, 58) = 43.84$, $p < .001$, $\eta^2 = .431$, which suggests that it was maximal at the after-movie rating. Indeed, mood ratings differed after the viewing of the movies, $t(59) = 4.88$, $p < .001$, but not at the start, $t(59) = 1.60$, $p = .12$, or end, $t(59) = 0.53$, $p = .53$, of the experiment. These results confirm that the happy movie altered mood immediately after viewing it, but that this effect washed out over the course of a less than exciting experimental task.

GENERAL DISCUSSION

We presented two experiments: a main experiment investigating the interactions between novelty, mood, and age, and a control experiment to ascertain that our manipulation of mood had the intended effect. Below, we discuss the findings of these experiments, starting with the effects of age, moving on to those of mood, and then to those of novelty.

Adults were generally faster and more accurate in responding to the auditory target than children, as were older children than younger children. The global difference hypothesis proposes that age-related changes are due to differences in processing speed (Kail, 1991, 1992, 1993; Miller & Vernon, 1997). Processing speed depends on myelination of white matter in the frontal lobes (Brouwer et al., 2012), which develops well into puberty (Klingberg et al., 1999). Slower processing speed could thus underlie the slower responses in children compared to adults. On top of such general effects, age differences in reaction time may vary as a function of the specific cognitive processing demands (Kiselev, Espy, & Sheffield, 2009). Specifically when response suppression is required, children are slower than adults. In the present auditory target detection task, a response was required on only 20% of trials, requiring response suppression on all other trials. This task characteristic may be a factor of influence in the observed age differences for response times.

No differences in mood ratings between the "happy" and neutral group were found at the end of Experiment 1, but a second experiment confirmed that this was probably due to mood effects washing out over the course of an experimental task. Indeed, the mood induction movie did affect accuracy and response times in Experiment 1. Children who saw the happy movie were faster than those who saw the neutral movie, whereas in adults no such effects of mood were observed. The finding in children is consistent with earlier reports that positive affect ameliorates performance on several cognitive tasks (Ashby, Isen, & Turken, 1999; Ridderinkhof et al., 2012; Van der Stigchel et al., 2011; van Wouwe et al., 2010). But children who saw the happy movie were less accurate at the 200-ms SOA and adopted a more liberal response criterion than children who saw the neutral movie and than adults. This combination of effects—faster, but less accurate responding, with a more liberal criterion—is consistent with increased alertness or arousal (Posner, 1978). Positive mood may thus have increased arousal in children, whereas positive mood had no such effect in adults (Fredrickson, 2004; Lackner et al., 2013; Posner, 1978). Alternatively, the mood induction movie may have had a weaker effect in adults than in children.

In contrast, all participants adopted a more conservative criterion during the presentation of novel than of standard images. Attention has been reported to increase perceptual sensitivity, but can also induce a conservative response bias (Rahnev et al., 2011). Our findings thus suggest that novel stimuli elicit a transient attentional response, inducing a more conservative criterion than standard stimuli, which is in line with previous findings of novel stimuli enhancing perception through an attentional mechanism (Schomaker & Meeter, 2012).

Mood not only differentially affected response speed for children and adults, but also affected the response to novelty in different ways. Children in the "happy" group were speeded by the novel images, while both children in the neutral group and adults did not show this effect. Again, the trend-level decrease in accuracy and the shift to a more liberal criterion were consistent with an increase in arousal for novel images, specifically in children that had seen the happy movie. This effect could be mediated by an increase in frontostriatal dopamine when children viewed the happy movie (Ridderinkhof et al., 2012), promoting novelty processing (Lisman & Grace, 2005; Rangel-Gomez, Hickey, van Amelsvoort, Bet, & Meeter, 2013), and increasing novelty's effects on behaviour. Novel stimuli have been reported to elicit a broader and more frontally oriented novelty P3 in children and a more parietally oriented component in adults (Brinkman & Stauder, 2008; Maatta et al., 2005; Wetzel & Schroger, 2007). These findings may reflect increased responsiveness to novelty in children compared to (young) adults (Wetzel & Schroger, 2007). A reason for such stronger responsivity to novelty in children may be that the frontostriatal dopaminergic circuits, relevant for novelty processing, undergo major changes in the first two decades of life (Brocki, Clerkin, Guise, Fan, & Fossella, 2009). With increasing age, striatal dopamine transporters decline, and dopamine receptors decrease (Seeman et al., 1987). For example, methylphenidate (the most commonly used treatment in attention-deficit hyperactivity disorder) typically increases dopamine, but responsiveness to this drug declines with increasing age (Volkow et al., 2001). Since positive mood is also associated with increases in frontostriatal dopamine, this may explain why children responded more strongly to the mood induction video than adults, which in turn affected novelty processing and its effects on response times.

Conclusions

In summary, children were generally slower and less accurate on the auditory detection task. Positive mood facilitated response times in children, but also reduced accuracy and induced a more liberal response criterion. No such effects were found in adults. Though novelty in general seemed to result in increased attentional orienting, children who had seen the happy movie adopted an even more liberal response criterion, suggesting that the novel images also increased arousal. This suggests that mood and novelty may affect behaviour more strongly in children than in adults.

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