Supplementary Materials

A. Details visual decision task

Visual decision task items consisted of a single line of constant length (L_1) and two separate line segments (L_2), the individual and combined length of which varied across items. Both the single line and two line segments were straight, vertical lines depicted next to one another. The objective was to indicate which is longer, L_1 or the combined length of L_2. Responses were given by checking the box corresponding the box.

Each item included external information pertaining to the correct response in the form of an answer by a supposed previous participant 'Robin', which was correct in 75% of items. If ranking the items from lowest to highest L_2, the second out of 4 items contained incorrect external information (i.e. incorrect information was given at item 2, item 6, item 10, etc.) This was done so that incorrect information would be spread equally across item difficulty. In the task, the items were presented in a random order, which was the same for all participants.

Items were created in R, for L_1 = 10, L_2 = [8.5 , 11.5], with L_2 increasing in steps of 0.025 (i.e. for item 1 L_2 = 8.5, for item 2 L_2 = 8.525, for item 3 L_2= 8.55, …., for item 120 L_2 = 11.5). Difficulty varied with the length of L_2, with items where the difference in length between L_1 and L_2 is smaller being more difficult. L_1 and L_2 were never of the same length.

The length of each of the two separate line segments was generated randomly, with a few restrictions. First, the line segment lengths would sum up to equal the L_2 length of that item. Second, the two segments of L_2 were constrained to have a difference in length of at least 1. Also, the line segments were displayed so that the shortest segment would always be closest to the single line (L_1). This was done as varying which segment of L_2 was shown closest to L_1 might affect item difficulty, which was intended to depend solely on the length of L_2.

Items were exported from R at a 240×240mm format, with a resolution of 144, resulting in the single line (L_1) having a length of 75mm, and the total length of the two separate line segments (L_2) varying between 63.75mm and 86.25mm in steps of 0.1875.

Information on 'Robin' (e.g. age, gender, whether getting 75% of items correct was good performance) was purposefully withheld (the name 'Robin' is unisex in Dutch and gender-specific pronouns were avoided). This was supposedly due to privacy regulations, but actually done to prevent such factors from influencing decision strategy use —which would be likely to happen (Lourenc et al., 2015).

The task consisted of 120 items, a reduced number as compared to the auditory decision task from the pilot. A small pilot with the visual task indicated that it took longer to complete than the auditory task, potentially because checking boxes takes longer than pressing buttons, or because participants rather than the computer determined the pace. Simulations showed that 120 items were sufficient to discriminate between different strategy models, and children indicated this length to be feasible.

The full R-code used in item creation is available on the Open Science Framework (OSF; https://osf.io/pe8jw/?view_only=4c3e221a699f475280b28f361206bcd5), under the name 'A. Line task (Study 2).R'.

B. Data analysis

Strategy model assignment and strategy parameter estimation are achieved through Bayesian hierarchical mixture modeling. Below the details of the model are explained. The codes are available on the OSF as: 'Analyses Study1.R' (pilot study) and 'Analyses Study2.R' (main study).

B1. Strategy Model Assignment

The model assigned to an individual is the one with the highest posterior probability. The posterior probability of each strategy model, per individual, can be calculated according to the Monte Carlo estimator, see Equation B1:

$$p(M_k|D) = \frac{Number\ of\ occurances\ of\ M_k\ in\ strat_i}{Total\ number\ of\ iterations\ in\ strat_i} \qquad \text{(Eq. B1)}$$

This utilizes model index parameter $strat_i$, a vector containing strategy model *M* assignment $k = \{1, 2, \ldots, K\}$ for individual $i = \{1, 2, \ldots, N\}$, across samples.

Evidence for assignment of model *k* over the other models is then quantified in terms of the Bayes factor, as calculated using the product space method (Lodewyckx et al., 2011; Steingroever, Pachur, Šmíra, & Lee, 2018), see Equation B2:

$$BF_{k,\neq k} = \frac{p(M_k|D)\ /\ p(M_{\neq k}|D)}{p(M_k)/\ p(M_{\neq k})} \qquad \text{(Eq. B2)}$$

In this equation, the numerator is the ratio of the posterior probability of model k and the summated posterior probabilities of all other models. The denominator is the ratio of prior probabilities of these same models. A BF is computed per individual for every model. The individual is assigned the model with the highest BF.

B2. Strategy Parameters

Strategy parameters refer to all parameters that inform behavior within all strategy models. In our hierarchical Bayesian model, we distinguish between group-level parameters and individual-level parameters (Boehm, Marsman, Matzke, & Wagenmakers, 2018; Lee & Wagenmakers, 2013). Group-level parameters inform the group-distributions from which individual-level parameters are drawn.

Our model utilizes shared group parameters, meaning that individual parameters shared by multiple models are drawn from a common group-distribution. Parameter b_{int} is shared by the internal, sequential, and integrative model, and parameter b_{ext} the external, sequential, and integrative model. Inclusion of shared group parameters improves model switching in $strat_i$ and is allowed as the parameters have the same interpretation across models, as is the case here (Carlin & Chib, 1995; Tenan et al., 2014).

B2.1. Strategy Parameter Priors

Individual-level parameters were drawn from Gaussian distributions with group mean μ and group precision λ. As b_{int} and b_{ext} were expected to be positive, their group means were given a uniform prior between 0 and 10. The group mean of parameter z of the sequential model was distributed uniformly, with a range of 0 to 1.73 (i.e. the range of S_Δ after standardization). Finally, as parameters of the guessing and bias models are probabilities, these are drawn from uniform distributions ranging from 0 to 1.

Instead of group precisions, we estimated group standard deviations (which are easier to interpret) for each distribution, and converted these to precisions ($\lambda = 1/\sigma^2$). The group standard deviation of each parameter was given by a uniform distribution ranging from 0.1 to 5 for all parameters. The lower bound was chosen to prevent what Lee and Wagenmakers (2013) refer to as the ‘zero variance trap’, an problem common to complex hierarchical Bayesian models wherein the variance parameter gets stuck at zero. This phenomenon was observed in earlier runs, obstructing parameter convergence.

B2.2. Strategy Parameter Constraints

An overview of individual strategy parameter constraints is given in Table B.1.

Table B1

Constraints of individual strategy parameter estimates.

Parameter	Constraint	Reason
b_{int}	$> -\ln(1/.6 - 1)$	to reflect that responding $L_2 > L_1$ increases as L_2 increases. Exact value chosen to be equal to the constraint on b_{ext}, so as not to unfairly (dis-)advantage
b_{ext}	$> -\ln(1/.6 - 1)$	to implement a ≥.6 probability of responding according to the external information in the external/sequential strategy model, thus distinguishing reliance on only external information from guessing
z	$> .1$	to prevent exchangeability of the sequential and internal strategy model (if $z = 0$)
	< 1.63	to prevent exchangeability of the sequential and external strategy model (if $z = 1.73$*)
P_{guess}	$> .45$ $< .55$	to reflect a probability close to .5 of ever responding $L_2 > L_1$
P_{L1}	$< .1$	to reflect a probability close to zero of responding $L_2 > L_1$
P_{L2}	$> .9$	to reflect a probability close to 1 of responding $L_2 > L_1$

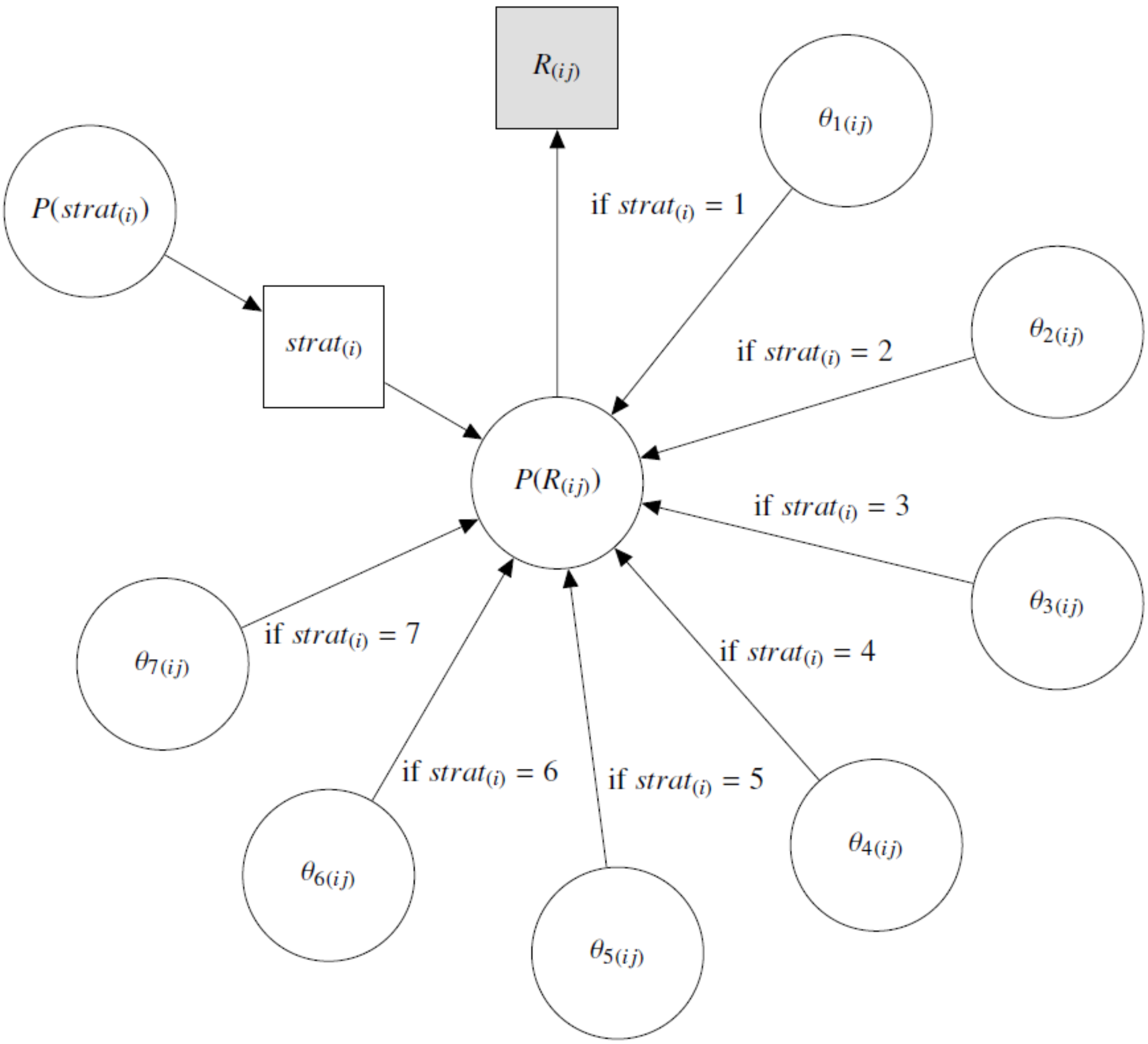
* parameter z is expressed in terms of $L_\Delta (= L_2 - L_1)$ in standardized absolute values, thus ranging from 0 to 1.73 in both studies.

B3. Graphical Representation

Below is depicted a graphical representation of the hierarchical Bayesian model, see Fig. B.1. Due to the size of the model, the model has been split into the part of strategy model assignment (top) and strategy parameter estimation (bottom).

Fig. B1

The graphical representation of the strategy models.



Response Prediction

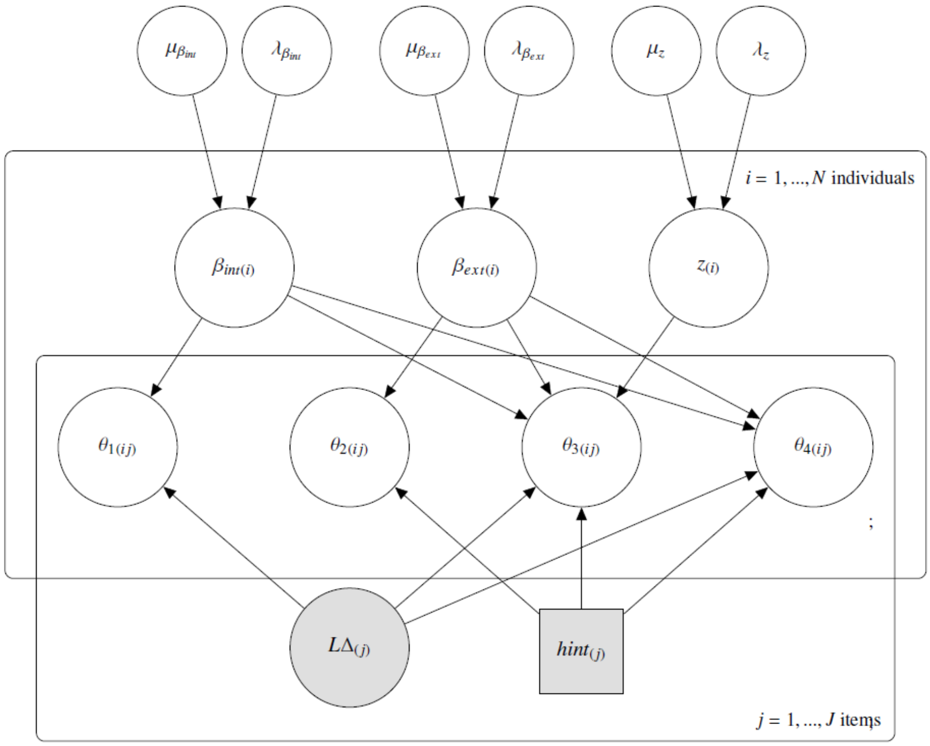
$$R_{(ij)} \sim Bernoulli(P(R_{(ij)}))$$

$$P(R_{ij}) \leftarrow \begin{cases} \theta_{1(ij)} & if\ strat_{(i)} = 1 \\ \theta_{2(ij)} & if\ strat_{(i)} = 2 \\ \theta_{3(ij)} & if\ strat_{(i)} = 3 \\ \theta_{4(ij)} & if\ strat_{(i)} = 4 \\ \theta_{5(ij)} & if\ strat_{(i)} = 5 \\ \theta_{6(ij)} & if\ strat_{(i)} = 6 \\ \theta_{7(ij)} & if\ strat_{(i)} = 7 \end{cases}$$

Model prediction

$$strat_{(i)} \sim Categorical(P(strat_{(i)}))$$

$$P(strat_{(i)}) \leftarrow 1/n_{strat}$$



Models

$$\theta_{1(ij)} \leftarrow \frac{1}{1 + e^{-(b_{int(i)} \times L_{\Delta(j)})}}$$

$$\theta_{2(ij)} \leftarrow \frac{1}{1 + e^{-(b_{ext(i)} \times hint_{(j)})}}$$

$$\theta_{3(ij)} \leftarrow \begin{cases} \dfrac{1}{(1 + e^{-(b_{int(i)} \times L_{\Delta(j)})})} & for - z_{(i)} \leq L_{\Delta(j)} \leq z_{(i)} \\ \dfrac{1}{(1 + e^{-(b_{ext(i)} \times hint_{(j)})})} & for\ elsewhere \end{cases}$$

$$\theta_{4(ij)} \leftarrow \frac{1}{1 + e^{-(b_{int(i)} \times L_{\Delta(j)} + b_{ext(i)} \times hint_{(j)})}}$$

$\theta_{5(ij)} \leftarrow P_{guess(i)}$
$\theta_{6(ij)} \leftarrow P_{L1(i)}$
$\theta_{7(ij)} \leftarrow P_{L2(i)}$

Parameters

$\beta_{int(i)} \sim Gaussian(\mu_{\beta_{int}}, \lambda_{\beta_{int}})\mathrm{T}(-\ln(1/.6 - 1),)$
$\mu_{\beta_{int}} \sim Uniform(0,10)$
$\lambda_{\beta_{int}} \leftarrow 1/(\sigma_{\beta_{int}})^2$
$\sigma_{\beta_{int}} \sim Uniform(.1, 5)$

$z_{(i)} \sim Gaussian(\mu_z, \lambda_z)\mathrm{T}(.1, 1.63)$
$\mu_z \sim Uniform(0, 1.73)$
$\lambda_z \leftarrow 1/(\sigma_z)^2$
$\sigma_z \sim Uniform(.1, 5)$

$\beta_{ext(i)} \sim Gaussian(\mu_{\beta_{ext}}, \lambda_{\beta_{ext}})\mathrm{T}(-\ln(1/.6 - 1),)$
$\mu_{\beta_{ext}} \sim Uniform(0, 10)$
$\lambda_{\beta_{ext}} \leftarrow 1/(\sigma_{\beta_{ext}})^2$
$\sigma_{\beta_{ext}} \sim Uniform(.1, 5)$

$P_{guess(i)} \sim Gaussian(\mu_{guess}, \lambda_{guess})T(.45, .55)$
$\mu_{guess} \sim Uniform(0,1)$
$\lambda_{guess} \leftarrow 1/(\sigma_{guess})^2$
$\sigma_{guess} \sim Uniform(.1, 5)$

$P_{L1(i)} \sim Gaussian(\mu_{L1}, \lambda_{L1})T(0, .1)$
$\mu_{L1} \sim Uniform(0,1)$
$\lambda_{L1} \leftarrow 1/(\sigma_{L1})^2$
$\sigma_{L1} \sim Uniform(.1, 5)$

$P_{L2(i)} \sim Gaussian(\mu_{L2}, \lambda_{L2})T(.9, 1)$
$\mu_{L2} \sim Uniform(0,1)$
$\lambda_{L2} \leftarrow 1/(\sigma_{L2})^2$
$\sigma_{L2} \sim Uniform(.1, 5)$

The graphical representation of all seven models predicting responses of individual $i = \{1, 2, \ldots, N\}$, across items $j = \{1, 2, \ldots, J\}$. The nodes represent variables/strategy parameters, wherein round nodes are continuous and square nodes categorical, white nodes are unobserved and colored nodes are observed. θ_{ij} is the probability of giving response 1 (i.e. "$L_2 > L_1$") instead of 0 (i.e. "$L_2 < L_1$") by individual i on item j; $P(R_{ij})$ is the probability of individual i giving response 1 instead of 0 on item j depending on which of the five models individual i was assigned to. Model assignment is captured in index parameter $strat_i$, which is determined prior probability to be assigned to individual i, $P(strat_i)$, and the probability of item responses as predicted by each of the different model. Top: the seven models combined, predicting the probability of a response, $P(R_{ij})$, using the model corresponding to the assigned strategy, $strat_i$. Bottom: prediction of θ_{ij}according to the internal ($\theta_{1_{ij}}$), the external ($\theta_{2_{ij}}$), the sequential ($\theta_{3_{ij}}$), the integrative strategy model ($\theta_{4_{ij}}$) as informed by their strategy parameters ($b_{int(i)}, b_{ext(i)}, z_{(i)}$) and variables describing item characteristics ($L_{\Delta(j)}$, $hint_{(j)}$). The guessing strategy ($\theta_{5_{ij}}$), and the two bias strategies, ($\theta_{6_{ij}}$ and $\theta_{7_{ij}}$) are not shown for simplicity.

C. Trace plots strategy assignment analysis

This supplement contains visual representation of the chains of both individual and group parameters, see file: 'C. Parameters Traceplots Study 2.pdf' on OSF. Note that the L_1 bias model is referred to as 'bias1' and the L_2 bias model as 'bias2'. Individual parameters are named according to the format: parameter_name[participant_number] (e.g. 'b1[23]' indicates parameter b1 of participant 23). Per individual we only inspected parameters of the assigned model to that individual (i.e. the model with the highest BF).

D. Strategy assignment and Bayes factors

Table D1

Strategy assignment and Bayes factors (per participant).

[Table D1 omitted due to size. See file: "D1. Strategy Assignment and Bayes Factors (Per Participant, Study 2).csv" on the OSF]

Individual strategy assignment, including Bayes factors (BF), for the analysis of the main study. Rows represent individuals. The column 'strat' indicates the model assigned to each individual, based on the product space method (see Supplement A1). Each column under 'BF' indicates the BF expressing evidence for the model indicated by 'strat' as compared to all, or one of the other models. Specifically, the column 'total' shows the BF of the assigned model (see 'strat') compared to all six other models. The subsequent columns contain the BF of the assigned model (see 'strat') compared to the model named in the column title (intern=internal model; extern=external model; sequen=sequential model; integr=integrative model; guess=guessing model; bias1=bias L_1 model, bias2 =bias L_2 model). Note that the best model compared to itself will always produce a BF of 1. If BF='Inf', this indicates no evidence in favor of the column model.

For BF interpretation we adhere to guidelines provided by Jeffrys (1961), as described in Lee and Wagenmakers (2013). Accordingly, evidence in favor of individual model assignments ranged from moderate to extreme.

Within-group model assignment was assessed using the product space method. The posterior probability of each model is calculated similarly to individual model assignment, except now the calculations happen across all participants within an age group rather than per participant, see Equation D1:

$$p(M_k|D) = \frac{Number\ of\ occurances\ of\ M_k in\ group_m}{Total\ number\ of\ iterations\ group_m}. \quad \text{(Eq. D1)}$$

Herein, $group_m$ is a vector containing strategy model assignment ($k = 1, 2, \ldots, K$) across participants in age group m ($m = 1, 2, \ldots, M$), across samples. Evidence for model k over the other models given the data is calculated identically to Equation B1, but the resulting BF now applies to a group, rather than an individual.

Table D2

BF values of strategy assignment per age group of main study.

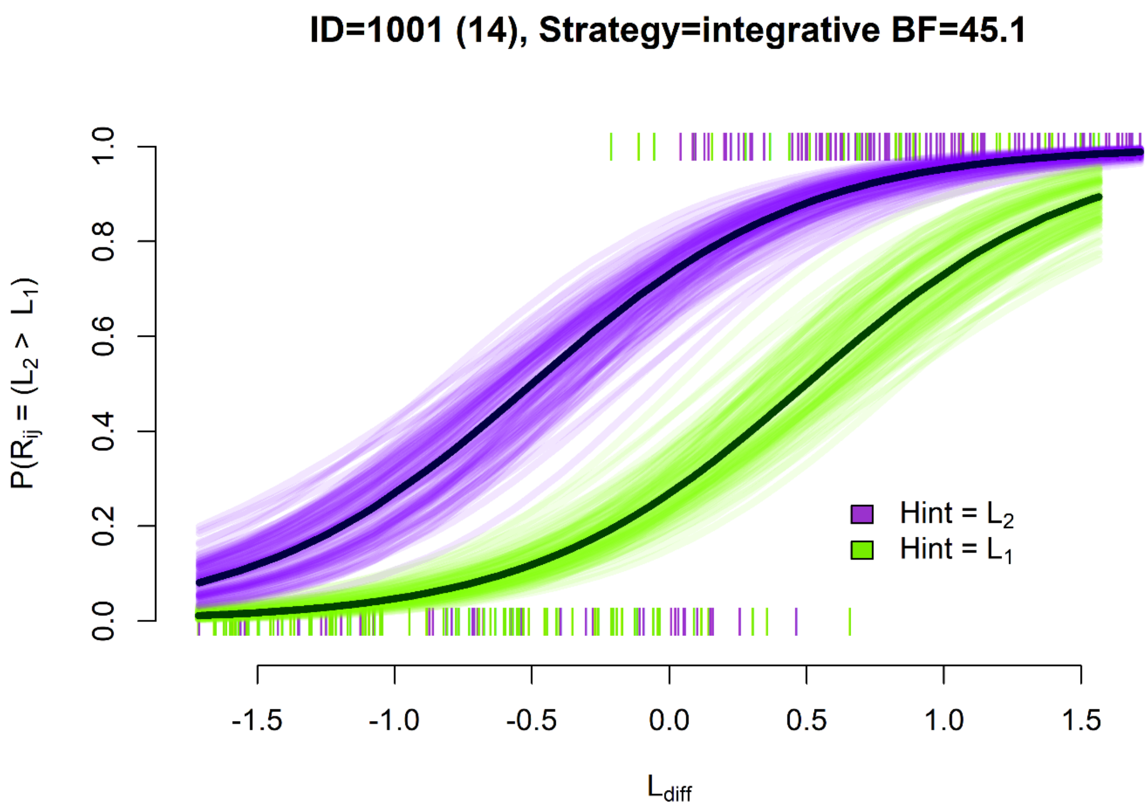
Age group	intern	extern	sequen	integr	guess	bias1	bias2
9 y.o. (*N*=34)	4.2	≤.001	2.3	2.7	≤.001	≤.001	≤.001
10 y.o. (*N*=54)	4.2	≤.001	2.9	2.0	≤.001	≤.001	≤.001
11 y.o. (*N*=47)	3.8	≤.001	2.9	2.3	≤.001	≤.001	≤.001
12 y.o. (*N*=64)	3.5	≤.001	2.2	2.7	≤.001	≤.001	≤.001
13 y.o. (*N*=74)	3.7	≤.001	3.2	2.2	≤.001	≤.001	≤.001
14 y.o. (*N*=32)	3.1	≤.001	1.8	4.5	≤.001	≤.001	≤.001

BF values of the respective model (see column name; intern=internal model; extern=external model; sequen=sequential model; integrate=integr model; guess=guessing model; bias1=bias L_1 model, bias2=bias L_2 model) versus all other models per age group of the main Study (*N*=305).

E. Graphical representation of individually assigned strategy models

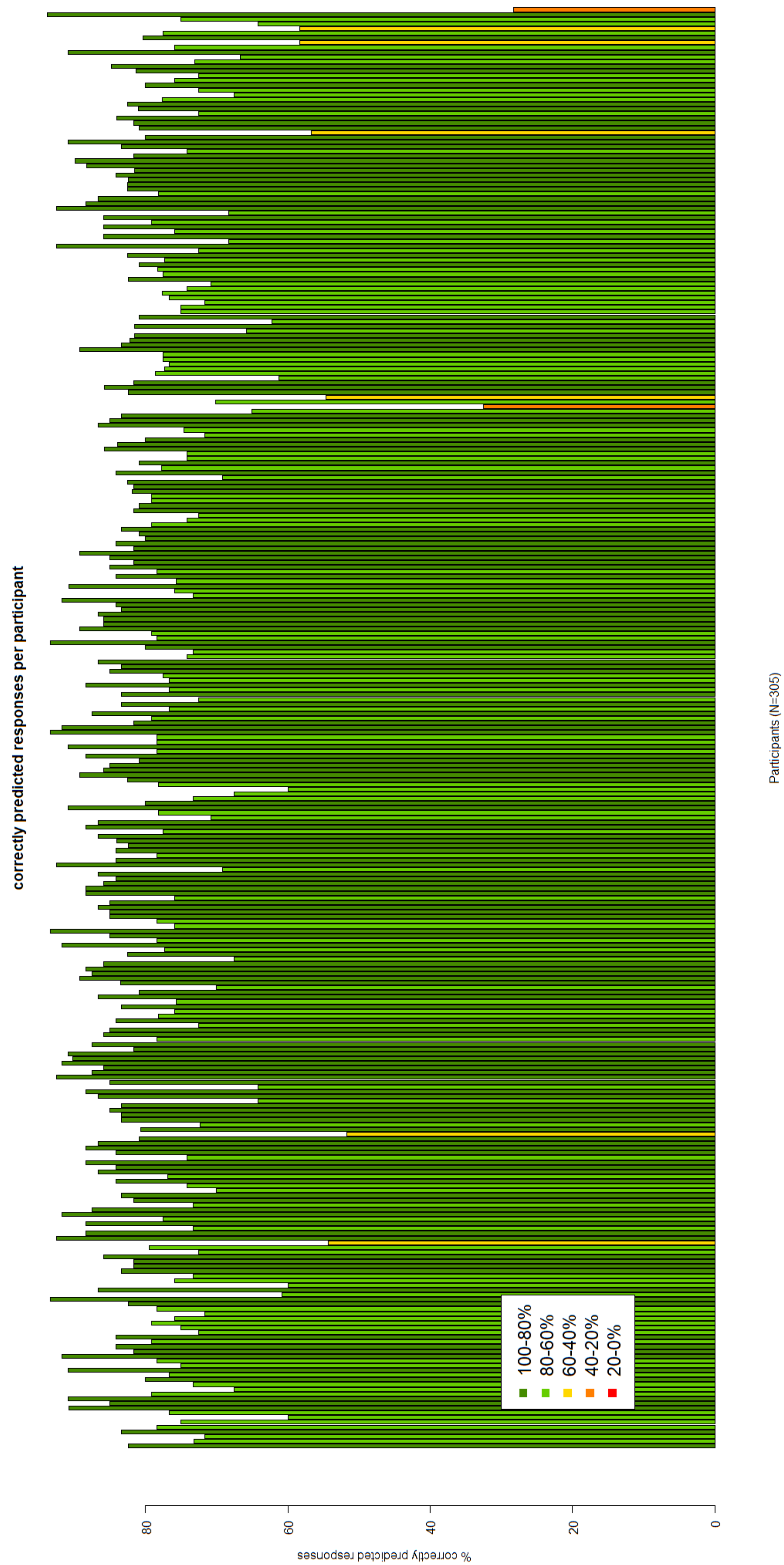
This supplement consists of a graphical representation of the assigned strategy model for each participant alongside observed responses. When computing individual strategy parameter estimates, we only considered samples wherein a model containing this strategy parameter was assigned. In other samples those strategy parameters are free-floating (i.e. randomly drawn from the prior-imposed range of values), rendering corresponding estimates uninformative. An example individual model is given in Fig. E.1.

Fig. E1



Graph of the assigned model for a fake participant (participant ID: 1001, age: 14 years old, assigned mode: the integrative strategy, Bayes factor: 45.1. The x-axis represents all possible values of the discrimination attribute for the varying stimulus (L_2). The y-axis represents the probability of responding "$L_2 > L_1$". The solid black lines represent the model as defined by the median of strategy parameter estimates across samples. The transparent lines represent the strategy parameter estimates of 100 randomly chosen samples. The vertical dashes (top and bottom) represent participant responses. Dash/line color denotes the nature of the hint on these item.

Fake participant 1001 was thus assigned the integrative strategy, with evidence 45.1 times in favor of the integrative as opposed to all other models. The black lines are spaced apart, indicating that external information had a pronounced effect on participant responses. This is consistent with the dashes on the top of the screen being predominantly purple, representing responses when the hint pointed towards L_2, and those on the bottom of the screen being predominantly green, representing responses when the hint pointed towards L_1. The transparent lines approximate the black lines, suggesting little variability in strategy parameter estimation across samples.


correctly predicted responses per participant
100-80%
80-60%
60-40%
40-20%
20-0%
Participants (N=305)
% correctly predicted responses
80
60
40
20
0

Graphical representation of individually assigned strategy model are found in: 'E. Visual Representation of Individually Assigned Models – Study 2.pdf' for all models on OSF.

The proportion of correctly predicted responses by the assigned model, per participant, are given in Figure E2 above, as well as Table E.1 on OSF.

F. Pilot study

The aim of this pilot study is to test whether the current task format elicited the use of internal and external information, and get a preliminary view of individual differences and age effects in strategy use.

F.1 Methods

F.1.1 Participants

A total of 67 individuals (12 children, 30 adolescents, 25 adults) participated.[1] Besides age group (children: ages 7-11; adolescents: ages 12-17; adults; ages 18-65), no demographic information was acquired.

Participants were recruited by contacting primary and secondary schools, after-school care centers, and direct and indirect acquaintances of the researchers. Only individuals between 7 and 65 years of age were approached, as children younger than this were expected to lack the reading skills required for the task, or have difficulty understanding the task and operating the computer. Individuals over 65, in turn, were more likely to suffer from reduced vision or hearing abilities, hindering them in the task. Relatedly, vision and hearing disabilities were exclusion criteria, as was epilepsy, which could potentially be triggered by screen changes of the computerized task.

Participants were sent an information letter explaining the research, and an informed consent form to sign upon agreement to participate. Participants over 16 years of age signed the form themselves, while younger participants required a signature from a parent or caretaker. Older participants were contacted about this directly, for younger participants schools and after-school care centers were asked to forward the letter and form to its destination. Participants were screened for exclusion criteria prior to participation. The study was approved by the UvA ethics committee. Participation was not compensated.

Participants were omitted from data analyses if they failed to respond to >10% of items, as too many missing data points could hinder accurate distinction between models (Bennett, 2001).

[1] Children: 7-12 years of age; adolescents 12-17 years of age, adults 18-64 years of age.

This study was approved by the University of Amsterdam ethics committee.

F.1.2 Materials

The auditory discrimination task consisted of 250 binary choice items wherein two tones differing in pitch frequency were presented, with the objective to indicate whether the second tone was higher or lower in pitch than the first. In concurrence with the main study, in this auditory task the first (i.e., constant) tone is referred to as L_1 and the second (i.e., varying) tone equals L_2). The computerized task was administered on two Dell Lattitude E5510s laptops, programmed and administered in Presentation version 17.0.0.1 (Version 17.0.0.1, Neurobehavioral Systems, Inc., Berkeley, CA, www.neurobs.com). Details on item generation can be found on OSF as supplement 'F1. pitchtask.sce'.

Pitch frequency of the first tone was constant at 440Hz, while that of the second tone varied between 425Hz and 455Hz. Participants indicated whether the second tone was 'lower' or 'higher' than the first by pressing the left or right shift-button, respectively. The response buttons on the laptops were marked with blank white stickers.

The first tone sounded for 500ms, followed by 500ms of silence, followed by 500ms of the second tone. External information appeared between 50 and 250ms after the second tone, in the form of a visually displayed hint, namely the word 'higher' or 'lower' appearing on-screen, see Fig. F1.

Participants were told that the hint was correct in 75% of items before starting the task. This correctness percentage struck a balance between guessing (50% correct, in which case there would be no logical reason to consider external information) and perfect discrimination (100% correct, in which case there would be no reason to consider internal information). The hint remained displayed until the participant had responded, after which the next item automatically started. There was no response time limit. Responses given before the hint were not registered. The tones were played at normal speaking volume (±60 dB). No feedback was provided.

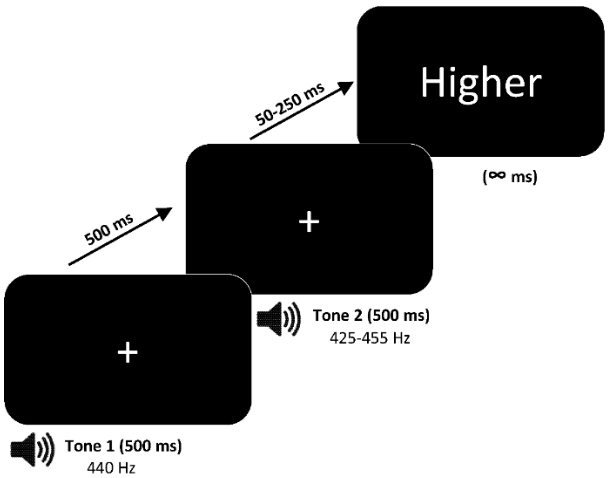
Prior to the task there was a practice round consisting of 3 items identical to the real items, including instructions, except hints were absent. The practice round and task took up approximately 5 and 15 minutes, respectively. Both the task and instructions were in Dutch.

F.1.3 Procedure

Test administration happened either in a classroom of the school or after-school center, or at the residence of the participant. The task was performed individually on a laptop provided by the researchers.

Fig. F1

The auditory discrimination task.



Two 500ms tones were played, intermitted by 500ms of silence. During this participants were shown a black screen with a white fixation cross. Between 50 and 250ms of silence after the second tone a word would be displayed in white letters on the screen until a response was given. In items containing hints the word would be either 'higher' or 'lower'. In this example item, the hint indicated that the second tone (L_2) was higher than the first tone (L_1). In practice items, the word displayed was always 'respond'.

The task without hints was administered first, the task with hints second. Both versions of the task started with instructions presented on screen, followed by a practice round, followed by the actual task. A researcher remained present for questions and to check if the task was understood. The participant was allowed to ask questions or refuse (further) participation at all times. The research included no deception.

F.1.4. Statistical analyses

The same Bayesian hierarchical mixture model analysis was used to assign strategies to individuals as in the main study. To test for age differences in strategy use, age groups were compared (i.e., child/adolescent/adult) on the posterior probability of both sequential and integrative strategy assignment versus other strategy assignment via Bayesian logistic regression (Kruschke, 2014). To test for age effects on strategy parameters we compared age groups on individual strategy parameters b_{int}, b_{ext}, and z using linear regression. To test for age effects on strategy parameters we compared age groups on individual strategy parameters b_{int}, b_{ext}, and z, using linear regression. Age effects are interpreted via their median and 95% CI.

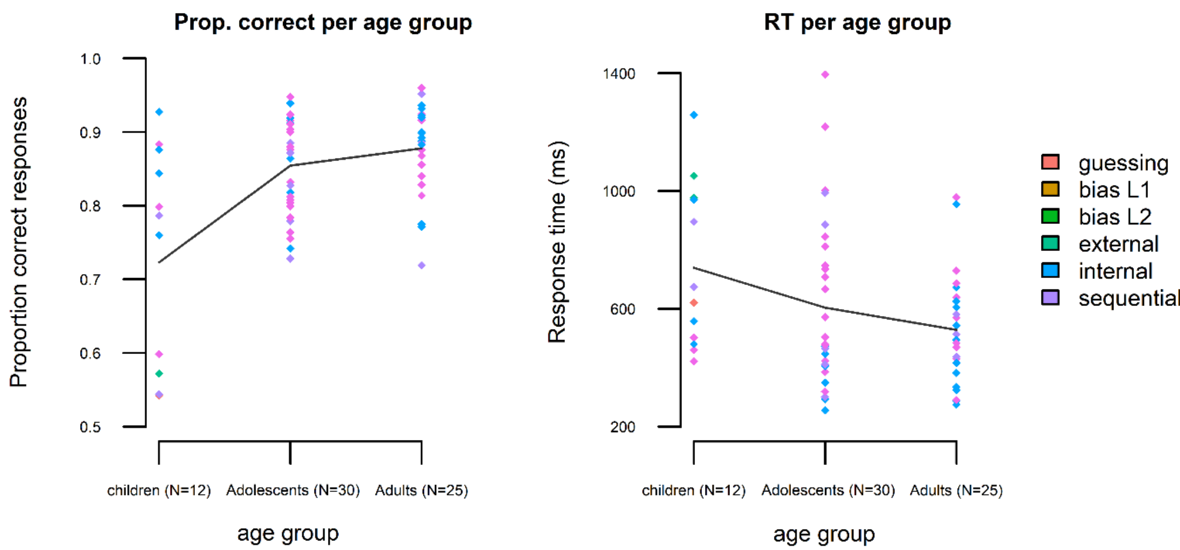
F.2 Results

F.2.1 Descriptive statistics

No participants were excluded for missing/early responses, leaving $N = 67$. First, we examined if accuracy and response time differed across age groups, see Fig. F2.

Fig. F2

Observed decision accuracy and response times per age group.



The proportion of correct responses of all age groups well exceeded guessing levels, indicating that (the majority of) participants understood the task and put effort into completing it.

A Bayesian linear regression indicated that adolescents had a higher proportion of correct than children,$b_{adoles-child} = .113, 95\%\ CI[.056; .166]$. The same was observed for adults, $b_{adult-child} = .135, 95\%\ CI[.079; .190]$. adults did not differ in proportion of correct responses, $b_{adult-adoles} = .022, 95\%\ CI[-.024; .067]$.

Adolescents had shorter mean response times than children, $b_{child-adoles} = -3.748$, $95\%\ CI[-22.692;\ 16.004]$, as did adults $b_{adult-child} = -3.103$, $95\%\ CI[-22.356; 16.773]$. Adults had longer mean response times than adolescents, $b_{adult-adoles} = .633$, 95%, $CI[-27.334; 27.889]$).

Secondly, after strategies were assigned, we examined if strategy use affected accuracy and response time. To disentangle these effects from the aforementioned age effects, strategies were compared per age group. Linear regressions showed only one effect, namely that accuracy was higher for the internal versus the external strategy model in the child group, $b_{internal-external} = .294$, 95% $CI[.092; .481]$. That is, within age groups strategy use differences did generally not relate to differences in accuracy or response time.

F.2.2 Main results

In the strategy assignment analysis, as based on the $\hat{R}$, 100% of group and individual parameters converged successfully. Visual inspection of trace plots supported this (see OSF, supplement 'F2. Parameters Traceplots Study 1.pdf').

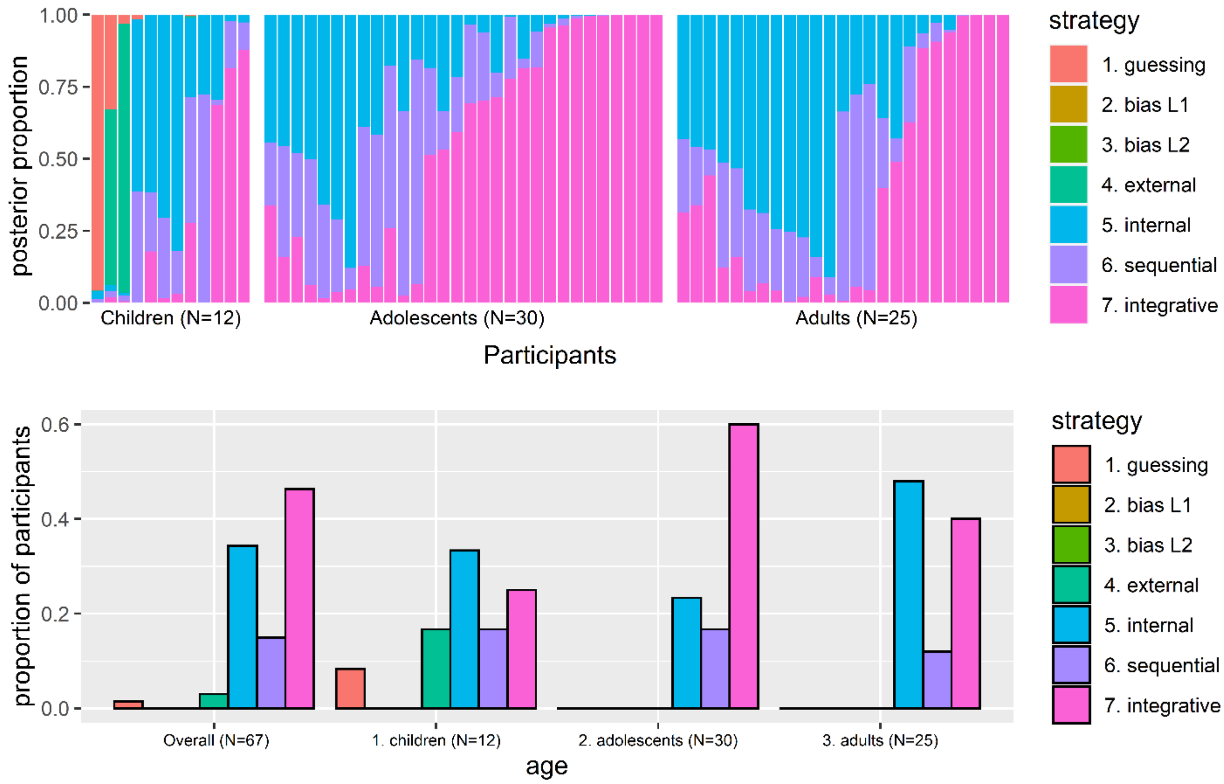
Visual representations of individual models provided an intuitive overview of individual differences in both decision strategies and strategy parameters (see OSF, supplement 'F3. Visual Representation of Individually Assigned Models – Study 1.pdf'). Individual posterior probabilities of strategy assignment, as well as resulting strategy model assignment overall and per age group, are shown in Fig. F3.

Bayes factors of individual strategy assignment ranged from moderate to extreme (see OSF, supplement 'F4. Strategy Assignment and Bayes factors (Per Participant, Study 1).csv'). In the children and adults group, the internal and the integrative strategy were equally common ($BF = 1.3$ and $BF = 1.0$). In the adolescents group, anecdotal evidence supported assignment of the integrative over the internal strategy ($BF = 2.4$), while moderate evidence supported assignment of the integrative over all other strategy models ($BF = 7.3$). A full overview of strategy model comparisons is given below.

A Bayesian logistic regression tested the effect of age group (categorical) on the posterior probability of integrative strategy assignment as compared to assignment of all other strategies. Adolescents had a higher probability of being assigned the integrative strategy model than children, $b_{adoles-child} = 1.562$, 95% $CI[.021; 4.196]$. This was not the case for adults, $b_{adult-child} = .916$, 95% $CI[-.701; 3.546]$. Adults and adolescents did not differ in probability of integrative strategy assignment, $b_{adult-adoles} = -.639$, 95% $CI[-1.555; .272]$.

Fig. F3

Strategy assignment.



The same analysis was performed for the sequential versus all other strategy model assignments. The sequential strategy model did not have a higher posterior probability of assignment in adolescents compared to children, $b_{adoles-child} = .138$, 95% $CI[-.968; 1.519]$, adults compared to children, $b_{adult-child} = .075$, 95% $CI[-1.046;\ 1.543]$, or adults compared to adolescents, $b_{adult-adoles} = -.059$, 95% $CI[-.851;\ .693]$.

Finally, three linear regressions were performed to see if age group affected strategy parameters $b_{int(i)}$, $b_{ext(i)}$, and $z_{(i)}$. Included were only participants assigned to a model containing the corresponding parameter ($N_{b_{int}} = 64$, $N_{b_{ext}} = 43$, $N_z = 10$). The only observed effect was that b_{int} was higher in adults than in adolescents, $b_{adult-adoles} = .880$, 95% $CI[.044;\ 1.715]$, indicative of adults more accurately deciding given internal information than adolescents.

F.3 Discussion

In this pilot study we investigated whether the task format elicited internal and external information utilization. Use of all four strategies of interest indicated that both internal and external information were used in the decision making process. We are thus confident in this operationalization of external information as hints with a correctness-percentage of 75% in its potential to influence decision making. Furthermore, all age groups performed above chance-levels indicated that effort was put into the task despite a lack of performance-dependent incentive. We conclude that the task format is suitable for investigating decision strategy use in our main study.

We observed an increase in integrative strategy use in adolescents relative to children. The sequential strategy was present but equally prevalent across age groups. The effect of internal information on decision making was higher in adults than adolescents. Accuracy and reaction time increased with age. Good parameter convergence, observed individual differences in strategy use and strategy parameters, as well as the observation of age effects in strategy use, suggested the model suitable for the study thereof.

Four limitations of this pilot study warrant mentioning. Firstly, the modest number of participants, especially children (N=12), may have led to misrepresentation of strategy prevalence and age differences therein. As such, we switch to a pen-and-paper task in the main study as to allow for simultaneous testing of large groups, thus boosting the sample size. Note that this format doesn't allow for sequential presentation of internal and external information, requiring simultaneous presentation instead. However, presentation order, given that only two pieces of information are presented, and responses are prompted after *all* information is presented, should not influence decision making (Morgan et al., 2012; Tubbs, Messier, & Knechel, 1990).

Secondly, the presence of guessing in children suggested that the task was hard to understand for younger participants. To ease comprehension, in the main study we present external information as answers from a supposed other person, rather than being computer-generated. Previous research suggests that both forms of external information influence decision making, with the effect of a human source matching or exceeding the influence of a computer source (Hertz & Wiese, 2016, 2018). This form of external information also aligns better with the pen-and-paper format, and may improve ecologically validity for real-life social decision situations.

Thirdly, the large age variation within age groups disallows specificity concerning the age at which effects occur, and whether such effects are sudden or gradual. We will therefore use more fine-grained age groups in the main study. In the main study, as opposed to the pilot, other demographic variables (i.e., sex and school level) are also collected to check for confounding effects.

Fourthly, we used the 95% CI of parameters to infer whether the differences/age effects they represented deviated from zero. However, this approach has since been criticized for being statistically incoherent (Wagenmakers, Lee, Rouder, & Morey, 2020) and alternatives such as the Savage-Dickey density ratio test (Wagenmakers, Lodewyckx, Kuriyal, & Grasman, 2010) have been advised instead. As both the pilot-study and the main study had already been (mostly) concluded at this point, we address this matter by providing a complete overview of findings using the Savage-Dickey method for both studies in Supplement H. The majority of analyses provide inconclusive results.

In summary, the pilot suggests that the current task is suitable for investigating individual differences and age effects in use of decision strategies of utilizing internal and external information. The most interesting age range herein appears to be the transition between childhood and adolescence, wherein an increase in integrative strategy use was observed —a potential explanation for the heightened susceptibility to peer pressure frequently observed in adolescents (Bednar & Fisher, 2003; Blakemore & Robbins, 2012; Dekkers et al., 2018; Gardner & Steinberg, 2005; Steinberg, 2005, 2008; Zwane, Mngadi, & Nxumalo, 2004). This developmental period will be the focus of the main study.

G. Comparison of task difficulty between the pilot study and main study

To examine potential differences in difficulty between the auditory decision task from pilot study and the visual decision task from the main study, we performed a Bayesian t-test (Kruschke, 2013) on response accuracy.

As the main study did not include adults and the pilot study indicated age-related differences in accuracy, adults were excluded from the pilot study sample. As in the main analyses, only participants with ≤10% missing responses were included ($N_{auditory} = 42$, $N_{visual} = 305$). Strong evidence indicated that accuracy did not differ between the auditory task and the visual task, $BF_{\mu_{hint\,(auditory-visual)}=0} = 32.0$ $\mu_{hint\,(auditory-visual)} = -.002$, 95% $CI[-.029;\ .032]$.

We conclude that any differences in findings between the pilot-study and the main study are not attributable to differences in decision task difficulty.

H. Findings using the Savage-Dickey density ration test

This section pertains to the findings of age effects in the pilot study (section H1-2) and the main study (section H3-4) using the Savage-Dickey density ratio test of hypothesis testing. Details on the interpretation of these Bayes factors are found in footnote 2 of the main paper.

Each analysis is run using two different sets of priors to examine potential differences in findings. As the wider priors showed similar or improved posterior predictive ability, these findings were reported in the main paper.

H.1. Overview pilot-study

Table H1

Overview of findings using the Savage-Dickey method of hypothesis testing for two sets of priors.

Effect	Narrow prior	Wide prior	Findings narrow prior	Findings wide prior
Prop correct changes with age?	Mu = 0 Sd = .1	Mu = 0 Sd = .5	Adolescent > child Adult > child Adult ? adolescent	Adolescent > child Adult > child Adult = adolescent
Response time changes with age?	Mu = 0 Sd = 10	Mu = 0 Sd = 60	Adolescent ? child Adult < child Adult ? adolescent	Adolescent ? child Adult < child Adult ? adolescent
Integrative strategy use changes with age?	Mu = 0 Sd = .5	Mu = 0 Sd = 1	Adolescent ? child Adult ? child Adult ? adolescent	Adolescent ? child Adult ? child Adult ? adolescent
Sequential strategy use changes with age?	Mu = 0 Sd = .5	Mu = 0 Sd = 1	Adolescent ? child Adult ? child Adult ? adolescent	Adolescent ? child Adult ? child Adult ? adolescent
Effect internal information increases with age?	Mu = 0 Sd = .1	Mu = 0 Sd = .5	Adolescent ? child Adult ? child Adult ? adolescent	Adolescent ? child Adult > child Adult ? adolescent
Effect external information increases with age?	Mu = 0 Sd = .1	Mu = 0 Sd = .5	Adolescent ? child Adult ? child Adult ? adolescent	Adolescent ? child Adult ? child Adult = adolescent
Switch internal / external information increases with age?	Mu = 0 Sd = .1	Mu = 0 Sd = .5	Adolescent = child Adult = child Adult = adolescent	Adolescent = child Adult = child Adult = adolescent

A "?" indicates that the comparison yielded insufficient evidence to support a claim concerning the presence of absence of differences between age groups.

H.2. Details pilot-study

H.2.1. The effect of age on proportion of correct responses

Prior 1: $b_{age} \sim Gaussian(\mu = 0, \sigma = .1)$

Table H2

Bayes factors and parameter estimate of the age effect corresponding to prior 1.

Comparison	$BF_{b_{age}=0}$	Param. Est	95% CI
Adolescent - child	$.002$	$.112$	$[.058; .167]$
Adult - child	$< .001$	$.135$	$[.080; .191]$
Adult - adolescent	2.7	$.022$	$[-.023; .069]$

A linear regression with a narrow prior (i.e., prior 1) indicated extreme evidence that adolescents had a higher proportion of correct responses than children, see Table H2. The same was observed for adults relative to children. The comparison of adolescents and adults produced anecdotal evidence only (1/3 < BF < 3; Lee & Wagenmakers, 2013), which was deemed insufficient to support or refute the presence of differences between these age groups.

Prior 2: $b_{age} \sim Gaussian(\mu = 0, \sigma = .25)$

Table H3

Bayes factors and parameter estimate of the age effect corresponding to prior 2.

Comparison	$BF_{b_{age}=0}$	Param. Est	95% CI
Adolescent - child	$.001$	$.113$	$[.072; .187]$
Adult - child	$< .001$	$.151$	$[.093; .211]$
Adult - adolescent	6.5	$.023$	$[-.023; .070]$

A Bayesian linear regression with a wider prior (i.e., prior 2) indicated extreme evidence that adolescents had a higher proportion of correct than children, see Table H3. The same was observed for adults. Moderate evidence supported that adults and adolescents did not differ in proportion of correct responses.

We conclude that adults and adolescents made more accurate decisions than children while adults and adolescents did not differ in decision accuracy.

H.2.2. The effect of age on response times

Prior 1: $b_{age} \sim Gaussian(\mu = 0, \sigma = 60)$

Table H4

Bayes factors and parameter estimate of the age effect corresponding to prior 1.

Comparison	$BF_{b_{age}=0}$	Param. Est	95% CI
Adolescent - child	$.699$	-87.5	$[-206.4; 31.1]$
Adult - child	$.118$	-148.6	$[-276.2; -28.6]$
Adult - adolescent	1.2	-61.0	$[-190.8; 64.3]$

A linear regression assessed potential differences in response time between age groups with a narrow prior, see Table H4. Moderate evidence supported adults to have shorter response times than children. Other group comparisons provided insufficient (i.e., anecdotal) evidence to draw conclusions concerning response time differences.

Prior 2: $b_{age} \sim Gaussian(\mu = 0, \sigma = 240)$

Table H5

Bayes factors and parameter estimate of the age effect corresponding to prior 2.

Comparison	$BF_{b_{age}=0}$	Param. Est	95% CI
Adolescent - child	$.600$	-132.1	$[-271.7; 5.1]$
Adult - child	$.065$	-202.6	$[-343.6; -59.6]$
Adult - adolescent	2.0	-71.0	$[-205.1; 60.3]$

The analysis was redone with a wider prior, see Table H5. Strong evidence indicated adults to have shorter response times than children. Other group comparisons were inconclusive as before. We conclude that adults made faster decisions than children.

H.2.3.The effect of strategy on accuracy, per age

Prior 1: $b_{age} \sim Gaussian(\mu = 0, \sigma = .1)$

Table H6

Bayes factors expressing evidence in favor of the accuracy of two strategies being equal corresponding to prior 1.

	Children	Adolescents	Adults
guess.vs.extern	1.7	-	-
guess.vs.intern	.7	-	-
guess.vs.seq	1.0	-	-
guess.vs.integ	.7	-	-
extern.vs.intern	.4	-	-
extern.vs.seq	.9	-	-
extern.vs.integ	.3	-	-
intern.vs.seq	.8	1.4	.5
intern.vs.integ	1.0	2.8	1.0
seq.vs.integ	1.2	1.8	2.0

intern=internal model; extern=external model; seq=sequential model; integ=integrative model; guess=guessing model; bias1=bias L_1 model, bias2 =bias L_2 model. A "-" indicates that one or both of the strategies were never assigned in this age group.

Pairwise comparison of strategy models on decision accuracy per age produced inconclusive findings, see Table H6. For corresponding parameter estimates, see supplementary Table H.1 on the OSF.

Prior 2: $b_{age} \sim Gaussian(\mu = 0, \sigma = .25)$

Table H7

Bayes factors expressing in favor of the accuracy of two strategies being equal corresponding to prior 2.

	Children	Adolescents	Adults
guess.vs.extern	3.7	-	-
guess.vs.intern	.2	-	-
guess.vs.seq	1.1	-	-
guess.vs.integ	0.5	-	-
extern.vs.intern	.1	-	-
extern.vs.seq	1.2	-	-
extern.vs.integ	.2	-	-

intern.vs.seq	1.1	3.2	1.5
intern.vs.integ	2.1	6.6	2.6
seq.vs.integ	1.6	3.7	4.1

intern=internal model; extern=external model; seq=sequential model; integ=integrative model; guess=guessing model; bias1=bias L_1 model, bias2 =bias L_2 model. A "-" indicates that one or both of the strategies were never assigned in this age group.

BFs for the pairwise comparison of strategy models on decision accuracy per age are found in Table H7. For children, the guessing and external strategy were characterized by less accurate decision making than the internal and integrative strategy. For adolescents, moderate evidence indicated no accuracy differences between strategies. For adults, moderate evidence supported the sequential and integrative strategy being equal in decision accuracy. Other comparisons were inconclusive. For corresponding parameter estimates, see supplementary Table H.2 on the OSF.

H.2.4. The effect of strategy on response time, per age

Prior 1: $b_{age} \sim Gaussian(\mu = 0, \sigma = 10)$

Table H8

Bayes factors expressing evidence in favor of response times of two strategies being equal corresponding to prior 1.

	Children	Adolescents	Adults
guess.vs.extern	1.0	-	-
guess.vs.intern	1.0	-	-
guess.vs.seq	1.0	-	-
guess.vs.integ	1.0	-	-
extern.vs.intern	1.0	-	-
extern.vs.seq	1.0	-	-
extern.vs.integ	1.0	-	-
intern.vs.seq	1.0	1.0	1.0
seq.vs.integ	1.0	1.0	1.0
seq.vs.integ	1.0	1.0	1.0

intern=internal model; extern=external model; seq=sequential model; integ=integrative model; guess=guessing model; bias1=bias L_1 model, bias2 =bias L_2 model. A "-" indicates that one or both of the strategies were never assigned in this age group.

Pairwise comparison of strategy models on response time per age indicated inconclusive results concerning response time differences between strategies, see Table H8.

Prior 2: $b_{age} \sim Gaussian(\mu = 0, \sigma = 60)$

Table H9

Bayes factors expressing evidence in favor of response times of two strategies being equal corresponding to prior 2.

	Children	Adolescents	Adults
guess.vs.extern	1.0	-	-
guess.vs.intern	1.0	-	-
guess.vs.seq	1.0	-	-
guess.vs.integ	1.0	-	-
extern.vs.intern	.9	-	-
extern.vs.seq	1.0	-	-
extern.vs.integ	1.0	-	-
intern.vs.seq	1.0	.6	.3
intern.vs.integ	1.0	.8	.4
seq.vs.integ	1.0	1.1	.9

intern=internal model; extern=external model; seq=sequential model; integ=integrative model; guess=guessing model; bias1=bias L_1 model, bias2 =bias L_2 model. A "-" indicates that one or both of the strategies were never assigned in this age group.

Pairwise comparison with a wider prior indicated moderate evidence for the internal strategy having shorter response times than the sequential strategy in adults, see Table H9. Other comparisons were inconclusive. For parameter estimates, see Table H.2 on the OSF.

H.2.5.The effect of age on strategy use

Prior 1: $b_{age} \sim Gaussian(\mu = 0, \sigma = .5)$

Table H10

Bayes factors and parameter estimate of the age effect on integrative strategy use corresponding to prior 1.

Comparison	$BF_{b_{age}=0}$	Param. Est	95% CI

Adolescent - child	1.2	−.075	[−.866; .705]
Adult - child	1.1	−.224	[−1.162; .864]
Adult - adolescent	.934	−.146	[−1.097; .839]

A logistic regression tested the effect of age group (categorical) on the posterior probability of integrative strategy assignment as compared to assignment of all other strategies, see Table H10. Findings concerning age-related changes in integrative strategy use were inconclusive.

Table H11

Bayes factors and parameter estimate of the age effect on sequential strategy use corresponding to prior 1.

Comparison	$BF_{b_{age}=0}$	Param. Est	95% CI
Adolescent - child	.821	−.075	[−..866; .705]
Adult - child	.950	−.224	[−1.062; .550]
Adult - adolescent	.362	−.146	[−1.162; .864]

The same analysis was performed for the sequential versus all other strategy model assignments, see Table H11. Findings concerning age-related changes in sequential strategy use were inconclusive.

Prior 2: $b_{age} \sim Gaussian(\mu = 0, \sigma = 1)$

Table H12

Bayes factors and parameter estimate of the age effect on integrative strategy use corresponding to prior 2.

Comparison	$BF_{b_{age}=0}$	Param. Est	95% CI
Adolescent - child	1.6	−.245	[−1.362; .941]
Adult - child	1.1	−.523	[−1.760; .692]
Adult - adolescent	1.4	−.288	[−1.648; 1.043]

Repetition of the previous analyses with a wider prior again provided inconclusive evidence concerning the presence or absence of age-related changes in integrative strategy use and sequential strategy use, see Table H13 and Table H12, respectively.

Table H13

Bayes factors and parameter estimate of the age effect on integrative strategy use sequential to prior 2.

Comparison	$BF_{b_{age}=0}$	Param. Est	95% CI
Adolescent - child	1.1	$-.560$	$[-1.654; .447]$
Adult - child	1.4	$.411$	$[-.648; 1.443]$
Adult - adolescent	.366	$.966$	$[-.092; 2.046]$

H.2.6.The effect of age on strategy parameters

Prior 1: $b_{age} \sim Gaussian(\mu = 0, \sigma = .1)$

Table H14

Bayes factors and parameter estimate of the age effect corresponding to prior 1.

Comparison b_{int}	$BF_{b_{age}=0}$	Param. Est	95% CI
Adolescent - child	1.0	$-.004$	$[-.190; .190]$
Adult - child	$.841$	$.062$	$[-.131; .248]$
Adult - adolescent	$.657$	$.067$	$[-194; .329]$

Comparison b_{ext}	$BF_{b_{age}=0}$	Param. Est	95% CI
Adolescent - child	$.909$	$.062$	$[-.039; .156]$
Adult - child	1.051	$.057$	$[-.049; .160$
Adult - adolescent	2.1	$-.004$	$[-.102; .090]$

Comparison z	$BF_{b_{age}=0}$	Param. Est	95% CI
Adolescent - child	7.9	$-.006$	$[-.030; .019]$
Adult - child	7.1	$.004$	$[-.027; .033]$
Adult - adolescent	5.9	$.004$	$[-.019; .038]$

Finally, three linear regressions were performed to see if age group affected strategy parameters $b_{int(i)}$, $b_{ext(i)}$, and $z_{(i)}$. Included were only participants assigned to a model containing the corresponding parameter ($N_{b_{int}} = 64$, $N_{b_{ext}} = 43$, $N_z = 10$). Evidence concerning age-related differences in b_{int} and b_{ext} was inconclusive, see Table H14. Moderate evidence indicated that parameter z did not differ between age groups.

Prior 2: $b_{age} \sim Gaussian(\mu = 0, \sigma = .5)$

Table H15

Bayes factors and parameter estimate of the age effect corresponding to prior 2.

Comparison b_{int}	$BF_{b_{age}=0}$	Param. Est	95% CI
Adolescent - child	1.1	.253	[−.409; .907]
Adult - child	.122	.773	[.087; 1.438]
Adult - adolescent	.476	.520	[−.187; 1.230]

Comparison b_{ext}	$BF_{b_{age}=0}$	Param. Est	95% CI
Adolescent - child	2.3	.097	[−.026; .212]
Adult - child	2.6	.095	[−.037; .223]
Adult - adolescent	10.0	−.001	[−.105; .099]

Comparison z	$BF_{b_{age}=0}$	Param. Est	95% CI
Adolescent - child	39.2	−.006	[−.032; .019]
Adult - child	36.1	.003	[−.027; .036]
Adult - adolescent	29.0	.009	[−.019; .039]

With a wider prior, moderate evidence indicated that effect b_{int} had a stronger positive effect in adults than children, see Table H15. This suggests that internal information influenced the decisions of adults more than those of children. Moderate evidence supported that the b_{ext} did not differ between adults and adolescents. Strong evidence indicated that parameter z did not differ between age groups. Other comparisons were inconclusive.

H.3. Overview main study

Table H16

Overview of findings using the Savage-Dickey method of hypothesis testing for two sets of priors.

Effect	Narrow prior	Wide prior	Findings narrow prior	Findings wide prior
Prop correct changes with age?	Mu = 0 Sd = .1	Mu = 0 Sd = .5	inconclusive	inconclusive
Integrative strategy use changes with age?	Mu = 0 Sd = .5	Mu = 0 Sd = 1	no age-related change	no age-related change
Sequential strategy use changes with age?	Mu = 0 Sd = .5	Mu = 0 Sd = 1	no age-related change	no age-related change
Effect internal information increases with age?	Mu = 0 Sd = .1	Mu = 0 Sd = .5	inconclusive	inconclusive
Effect external information increases with age?	Mu = 0 Sd = .1	Mu = 0 Sd = .5	no age-related change	no age-related change
Switch internal / external information increases with age?	Mu = 0 Sd = .1	Mu = 0 Sd = .5	no age-related change	no age-related change

"inconclusive" indicates that the analysis yielded insufficient evidence to support a claim concerning the presence of absence of an age-related change

H.4. Details main study

H.4.1. The effect of age on proportion of correct responses

Prior 1: $b_{age} \sim Gaussian(\mu = 0, \sigma = .1)$

A linear regression (*N* = 305) using a narrow prior (i.e., prior 1) provided inconclusive (i.e., anecdotal) evidence concerning age-related changes in decision accuracy, $BF_{b_{age}=0} = .899$ (b_{age}=.008, 95% CI[.002; .014]).

Prior 2: $b_{age} \sim Gaussian(\mu = 0, \sigma = .25)$

Repetition of this analysis with a wider prior (i.e., prior 2) rendered similar results, $BF_{b_{age}=0} = 2.2$ (b_{age}=.008, 95% CI[.002; .014]).

Based on these data, we cannot draw definitive conclusions concerning age-related changes in decision accuracy.

H.4.2. The effect of strategy on accuracy, per age

Prior 1: $b_{age} \sim Gaussian(\mu = 0, \sigma = .1)$

Table H17

Bayes factors expressing evidence for accuracy of two strategies being equal corresponding to prior 1.

	9y.o.	10y.o.	11y.o.	12y.o.	13y.o.	14y.o.
guess.vs.biasL1	-	-	-	1.5	-	-
guess.vs.biasL2	-	-	-	-	-	-
guess.vs.extern	-	-	-	-	-	-
guess.vs.intern	-	<0.05	-	<.01	.6	-
guess.vs.seq	-	.3	-	.2	.3	-
guess.vs.integ	-	.1	-	<.01	<0.5	-
biasL1.vs.biasL2	-	-	-	-	-	-
biasL1.vs.extern	-	-	-	-	-	-
biasL1.vs.intern	-	-	-	<.05	-	-
biasL1.vs.seq	-	-	-	.5	-	-
biasL1.vs.integ	-	-	-	<.05	-	-
biasL2.vs.extern	-	-	-	-	-	-
biasL2.vs.intern	-	-	-	-	-	-
biasL2.vs.seq	-	-	-	-	-	-
biasL2.vs.integ	-	-	-	-	-	-
ext.vs.intern	-	-	-	-	-	-
ext.vs.seq	-	-	-	-	-	-
ext.vs.integ	-	-	-	-	-	-
intern.vs.seq	1.4	3.4	3.7	1.7	4.3	3.3

intern.vs.integ	2.4	4.1	2.7	1.6	2.6	3.5
seq.vs.integ	1.9	3.1	1.7	.3	3.4	3.2

intern=internal model; extern=external model; seq=sequential model; integ=integrative model; guess=guessing model; bias1=bias L_1 model, bias2 =bias L_2 model. A “-” indicates that one or both of the strategies were never assigned in this age group.

Pairwise comparison of strategy models on decision accuracy per age indicated, firstly, that the guessing and bias strategies were characterized by less accurate decision making than the internal, sequential, and integrative strategies in 10-, 12-, and 13-year-olds, see Table H17. Moderate evidence indicated that the internal, sequential, and integrative strategy did not differ in accuracy for ages 10, 11, 13, and 14. Results of age 9 and 12 were inconclusive. For parameter estimates, see Table H.3 on the OSF).

Prior 2: $b_{age} \sim Gaussian(\mu = 0, \sigma = .25)$

Table H18

Bayes factors expressing evidence for accuracy of two strategies being equal corresponding to prior 2.

	9y.o.	10y.o.	11y.o.	12y.o.	13y.o.	14y.o.
guess.vs.biasL1	-	-	-	2.5	-	-
guess.vs.biasL2	-	-	-	-	-	-
guess.vs.extern	-	-	-	-	-	-
guess.vs.intern	-	<.05	-	<.001	.6	-
guess.vs.seq	-	.1	-	.1	.3	-
guess.vs.integ	-	<.01	-	<.001	<.05	-
biasL1.vs.biasL2	-	-	-	-	-	-
biasL1.vs.extern	-	-	-	-	-	-
biasL1.vs.intern	-	-	-	<.05	-	-
biasL1.vs.seq	-	-	-	.4	-	-
biasL1.vs.integ	-	-	-	<.01	-	-
biasL2.vs.extern	-	-	-	-	-	-
biasL2.vs.intern	-	-	-	-	-	-
biasL2.vs.seq	-	-	-	-	-	-
biasL2.vs.integ	-	-	-	-	-	-
ext.vs.intern	-	-	-	-	-	-

ext.vs.seq	-	-	-	-	-	-
ext.vs.integ	-	-	-	-	-	-
intern.vs.seq	2.8	8.5	8.9	3.9	10.5	7.9
intern.vs.integ	5.6	9.5	6.5	3.8	6.3	8.9
seq.vs.integ	4.1	7.6	4.0	.7	8.1	7.7

intern=internal model; extern=external model; seq=sequential model; integ=integrative model; guess=guessing model; bias1=bias L_1 model, bias2 =bias L_2 model. A "-" indicates that one or both of the strategies were never assigned in this age group.

With a wider prior, moderate to strong evidence indicates the absence of accuracy differences between strategies of interest across the entire age range. Accuracy differences between the guessing/bias strategies and the strategies of interest were more pronounced. For parameter estimates, see Table H.4 on the OSF).

We tentatively conclude that there were no differences in accuracy between the strategies of interest. However, the strategies of interest were related to more accurate decision making than the guessing or bias strategies.

H.4.3. The effect of age on proportion of strategy use

Prior 1: $b_{age} \sim Gaussian(\mu = 0, \sigma = .5)$

A logistic regression using the narrow prior provided moderate evidence that age did not predict the probability of integrative versus other strategy assignment, $BF_{b_{age}=0} = 7.6$ (b_{age}=-.022, 95% CI[-.140; .098]), nor the probability of sequential versus other strategy assignment, $BF_{b_{age}=0} = 7.7$ (b_{age}=-.011, 95% CI[-.115; .139]), or the probability of combined integrative and sequential strategy use versus other strategy assignment, $BF_{b_{age}=0} = 8.0$ (b_{age}=.027, 95% CI[-.081; .014]).

Prior 2: $b_{age} \sim Gaussian(\mu = 0, \sigma = 1)$

Repetition of these analyses with a wider prior provided strong evidence that age did not predict the probability of integrative versus other strategy assignment, $BF_{b_{age}=0} = 15.7$ (b_{age}=-.022, 95% CI[-.143; .093]), nor the probability of sequential versus other strategy assignment, $BF_{b_{age}=0} = 15.2$ (b_{age}=.010, 95% CI[-.119; .137]), or the probability of combined integrative and sequential strategy use versus other strategy assignment, $BF_{b_{age}=0} = 15.8$ (b_{age}=-.027, 95% CI[-.082; .138]).

We conclude that sequential and integrative strategy use did not change with age.

H.4.4. The effect of age on proportion of parameter estimates

Prior 1: $b_{age} \sim Gaussian(\mu = 0, \sigma = .1)$

Three linear regressions using a narrow prior were performed to see if age predicted strategy parameters $b_{int(i)}$, $b_{ext(i)}$, and $z_{(i)}$, including only participants assigned a model containing the corresponding parameter ($N_{b_{int}}$ = 300, $N_{b_{ext}}$ = 158, N_z = 64). The data provided inconclusive evidence for age-related changes in b_{int}, $BF_{b_{age\_int}=0} = .678$ (b_{age_int}=.046, 95% CI[-.002; .095]. Moderate to extreme evidence supported that b_{ext} and z estimates did not increase with age, $BF_{b_{age\_ext}=0} = 3.2$ (b_{age_ext}=.011, 95% CI[-.001; .023]); $BF_{b_{age\_z}=0} = 168.0$ (b_{age_z}=.000, 95% CI[-.001; .001]).

Prior 2: $b_{age} \sim Gaussian(\mu = 0, \sigma = .5)$

Re-analysis with a wider prior again provided moderate to extreme evidence that b_{ext} and z estimates did not increase with age, $BF_{b_{age\_ext}=0} = 15.5$ (b_{age_ext}=.011, 95% CI[-.001; .023]); $BF_{b_{age\_z}=0} = 848.9$ (b_{age_z}=.000, 95% CI[-.001; .001]). Findings concerning age-related changes in b_{int} remained inconclusive, $BF_{b_{age\_int}=0} = 2.7$ (b_{age_int}=.050, 95% CI[-.001; .100]. We conclude that neither the effect of external information on decision making or the switching point between internal and external information use in the sequential strategy changed with age. Based on these data, we cannot draw definitive conclusions concerning the effect of internal information on decision making changing with age.

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