



“(/ f f [~ z f f ~ 2 f f # & # . ~ z f f ~ f # @ " / , 1 / Z) .

fl i fL "fi) .(/fl ' žffli " ž f# /fl 9, ' fl(" fl M\$ i žž# , @ ' ž ") , fl ,
 i / ") ž i fi / fff žfv " ž ž ! # # ž ") , (/fl ' žffli " ž f# @ / ž) , \$) " # fl \$ " A
 4 " žffli " ž f# @ fl , fl 2" fl " ž ") , ž ") , / fl (ž / fl i / fff i fi) * fl * ,
 / fl (ž ' ? # / " ž ") , / fl (ž ' i / fl { ? # / A : / " / " fl (, fl ' / fff i) , ž " # *
 fl fl / " " ž fl / 2 " ž / fl ' # i " žffli) " # fl " # A 6 " # # ž ! @ ž # " fl / fl () ,
 " ž i / fl) ž i " @ " fl " L " i ž fl fv " / " > " # & ž ") @ ž # ž " fl ?) , \$! fl " ,
 8 / (" fff " / " > ž (ž " 5 " # ž fl " , E fl fi i fl " , 9 ž # fl 8 " " ž : / fl (ž , P " ? " fl
 # fl , ž ") , \$! fl " 8 / (" fff " / fl E fl fi i fi " 2 , > ž (ž " ž ") , 4 " (ž " = ž \$ S i f # ,
 = " / " / " E # i " / 2 i ž " ž ") , 8 / 2 " fl ? " , = " " i " # , E " & " 2 , P " ? " fl # fl A
 7 / fl () , i / # " @ ž # / \$ fl ") , fl (" ž i " / " fl " žffli " ž f# \$ / fl , fl " ,
 , " fl (" fA 4 " fl fi " ž f# fl i " ?) , (/ " fl fl i / (" " # fl fv " / fl fl & " 2 ,
 ' žffli " fl " , " fl (" fA

Stimuli and procedure

E žffli " ž f# @ fl , # ž fi) , KG, i (, ž @ ž ! , fl (, ž , (/ " fl fl BW, × OO, i (, . ,
 fl " fl # , fl fl k / GG, > U, fl # ž fv " k / GFV, × KCl , " ; " # D i / " " i fi) , fl , ž , E 8 ,
 @ fl , fl " fl " ž) , / # fl v ") / " ž , i " " fl # fl " ž) (! * 2" fl) , ž ") , # ž ") * ,
 žffli ž ž fi) , fl / (A 9 , ' fl (" f# , @ fl , fl " , @ fl , E # i " / " ! # i # 6 / / \$, ,
 B fl " ž fi) , / HK , " fl fl W @ @ A # i " fl / \$, A fl 2 VD / " ,

' žffli " ž" f# @~ fl ž#&~) ,fX ,i/(' ~ fl ž, # fl" #/ " #ž \$S i fl?~ , fl ž fl" 2, %ž" #
fV" #_BK" /" f#- & ffd, " i Ž) " 2, B/ D8/ " ffX , \$ " " " ž" 6/ , @ " ž fl" , fl " fl) / ,
! / Ž, " " , fl ž fl fl " ,

"zi""fzfi #, #Z\$#%Z~ f|' f|/f(z i i) "") #, fZi "z i !, , f f " i " / i ~ * ,
 /Zfi/(f f ' z f v ~ A6 / Z f f f f i ? f i ' f f # ' z f i f i . @ i / ' ' z f i) f i ~ 56,
) "" f i ' i ~ \$ f @ ~ ~ f i ~ ? / Z ~ f z i i z ~) / f i) . " / i ~ i /) " f v ~ # z i f x # #,
 f i ~ f i f i ~ , ' f i (~ f # B "2AFL A6" (z ~ , ~ i f i / ~ , ~ f i (~ f # @ z #,
 #2 " C i z ~ f i , B F , Q H D = / G A F , o < A G G / . , f = G A F i A ; z f f i f i ' z ~ f @ # ,
 i / (' z f i # ~ # , @ f i , / ~ ~ f f x ~ , i / f f i i f v ~ # / @) , f i z f i f i ~ " z i ~ f z f i f i ,
 ~ ~ ~ i f # / ~ ? / Z ~ f z f i i " / i ~ Z ~) ~ f i / ~ C f (~) i z z # f v ~ B F , ' f i (~ f i / 4 D
 z ~) , Z ~ f i ? z ~) , f i z f v ~ , B 9 , ' f i (~ f i / D @ ~ f i , z f z f i f i z ~ f i ~ , ~ ~ ~ i f i
 Z ~) ~ f i) ~ ~ z f i) i z z # f v ~ B 9 , ' f i (~ f i / 8 D z ~ o # < G A G G / @ ~ f i z # f i ~ f i ,
 @ z # /) ~ ~ ~ f i ' i ~ \$ f @ ~ ~ ~ f i ~ / f (~ f i f @ / ~ , ' f i (~ f # , o > A H H A 6 " Z # ,
 9 , ' f i (~ f i / # Z 2 2 ~ # f i) , f i z f i (z & ~ 2 z ~ ? / Z ~ f z f i i " / i ~ , (z i ' (' f x ? ~ ,
 ' f i / f (z ~ i ~ z # , / ~ 2 z # i " / i ~ ? Z f i / (~ i z z # f v ~ , # " Z ~) ~ ~ z f i) " A

Experiment 3: Conceded, unrevealed, and defeated choice-outcome causation in an within-subject design

7, 9, ' f i (~ f i f @ ~ f i , @ ~ z (~) , f i , f i ' i z f i , 9 , ' f i ~ ~ f i / ~ @ f i z ,
 @ f i ~ ~ # Z \$ \$ i i) ~ # 2 ~ , f i ~ f B B " / i ~ , o ! ~ i ~ z ? / Z ~ f z f i , ? A / f i ~) D i < O ,
 B B " / i ~ ? Z f i / ~ , 5 ~ z f v ~ i / ~ C f (~) , Z ~ f i ? z ~) , # A) ~ ~ z i) D
 f i ~ z f i) * (z ~ z f i # 4 : < i ~ z ~ / @ ~) z (z ~ ~ ~ i f v ~ 8 " / ~ , 6 ! ~ , B / ,
 F Q D = K A F G , o = A G / O , o = G A F , @ f i , 56 # / ~ , ? # Z z ~ # z f i " , \$ ~ ~ 2 ,
 2 ~ ~ f z ~ ! " z # f i f i f i f i ~ ? / Z ~ f z f i i " / i ~ , i / ~) f v ~ , f i z ~ / f i f i ~ / ~) ,
 i " / i ~ i / ~) f v ~ A 6 ~ (z ~ , ~ ~ i f i / ~ 8 / i ~ ? Z f i / (~ , 5 ~ z f v ~ @ z # ~ / f i
 # 2 " C i z ~ f i , B F , M F D = G A H , o = A I / H , o = G A G O A X ' / f z f i f i ! , f i ~ f i ~ @ z # ,
 z # 2 " C i z ~ f i ~ f i f z i f v ~ , ~ ~ i f j B " 2 A C 4 D , B F , M F D = O A M , o = A G C K , o =
 G A F A E z ~ ~) , t - f i # f v ~ , # (' ~ ~ ~ i f # # / @ ~) , f i z f i ' z f f i i " z ~ f # , f i # / ~

;/f[fl`,\$/Z)zfl,#zffzfv`a B`2AQ D,fl`F,x F,(;`)*(`z#zfl#
4: <l 4,#/#@) / #2`Ci z` fl` z` i,j,z` #B`./l OD</.#>
GAVH,\$Zfjz,#`Ci z` fl` fi flz i /`,\$`f@`"8"/i`6!`"z`),9,`ft*
(``fjz fl`Z` /./l OD=l AOK,`p = AGGV,`q = GAGVAE`z`))t-fl`#f#/
#(``i`"i f#`#/@)z f j`"fl`"i` fl(``f#`@`fl`i /`Cf(`)VZ`fl`*
?`z`)fl`zfv`"fl`a Qz`#2`"Ci z` fl` /`@`fl`"fl`?`Z`fz fl`i"/i`
i /`)"fv`"fl`z`"fl`"fl`"i"/i`i /`)"fv`"BGX//V,`?#A GAX/VMD,t
B//GD= FAKK,`p = AGG,`d = GAFQ,`@`"fl`z`"fl`"i` fl(``f#`@`fl`
)`z`fl`),i z`z`fv`"fl`"i`"i`@z`#` /fj`#2`"Ci z` fl` BGX/FI`?#A
GAX//GD,t BKOD= /A/K,`p = A'VM,d = GAXK,`; G/ = FAKFA
;/f[fl`"/`*)`i`#/#`fl(`"Ter B`2AC8D,fl`F,x F,(;`)*(`z#zfl#
4: <l 4,#/#@) /`"!`z`#2`"Ci z` fl`

)~fi f(~~~2,@~ff~flž!~fl~'fžž'~?~fi"#ž' /Žfi/(~ /"/~'~#žifV~#
/fl~/fjB9'fž(~fjž'A,FG/Qj,Xžf#~fjž'A,FG/Qj,Xžf#~ 9'fž(~,FG/MDA
N/fl/?~fl~fl~'~~~~2/~/~)~ff(~~~2,ff~/Žfi/(~,\$! ,fž&~2,?/Ž' fžfl ,
žifV~#(ž! ,š,~ff fl fl fi) ž#ff~ , ,~ff~' /"~"fl~@~'~" B žž(~#ff fl ,
FGGI Dž~)~)Ži ~2)~#š~~~~~"fl~@~'žff~'Žžfi,(/fl fl fl # /# #fl ž ,
?/Ž' fžfl ,žifV~ ,B5'2/~~ ,fjž'A,FG//Dž~) ,fl)Ži ~ ,š"ž?/fž ,ž) Š#ff
(~ffž"fi flž!~ff/fl(ž' i ,ffflB5'2/~~ ,1 ~%ž~~ , fž##, Žfi~ ,FG/ODA
6"~ ,j/~/?~fg

Implications of the current study

P#~ 2,fl~?~#Zz~.#zfl" ,fz#&Z#z~ ,z(' ' ,fl~ jZfffl~ f|fz) ! j / # ! ,
~?~ #f1z2zfi) ,fl~ ,j / ~) 'fV~ #,@" ~ fl , ' fl/f(z~ i , #~ _Z~ i ~) , \$! ,B?~ ,
fz#&^ffl ~?z~ fD,

8z# žfi,9A4A,8" fi#fi" #` ,\A; A,8"" fi (ž` #,4A,` ,>ž22žfi) .EABFG/OD8/" fi /" ž` 2` #,
 fi` ,#` # /" ž2` ! ! ,"" ,fi` , " Ž(ž` , \$fz` " ACurrent Biology, , ,MIMMFA" fi #WY/` A
 /f2WGA/G/ON8A Ž\$F/G/MX FAGOK,
 8" ž(\$/` ,I A,6" "fX` ,>A,I) ž` ,N A,I ž`)"" fi` ##" , ,>A, >ž22žfi) , EA,` , Ež("" fi fi, =A
 BF GFGDA7 / f(žfV` , žS/ Žfi ži fV` / Žfi/ (` #) "" fi` fi ž` ! , ž` ! fi, "" žfi "" 2" fX(, #` ""
)` fi fi ("") ? f#ž#(` / #) ,I" / i` #ANature Human Behaviour, , /GOK- /OKHA
 " fi #WY/` X f2WGA/GOI VVW/MDF`GFG`GH/H`M
 8" fi#fi` #` ,\A; A,L` 8/ #ž. =A, ` i & , A,` , >ž22žfi) . EABFG/HDA7,S#fi / #fi` fi, " žfi(ž`) ,
 ž` 2` fi fi) Ži` , fi` #` # /" ž2` ! ! ž4, #ž) ! , Ž#` 2, "" fi` fiV` ž` , \$"" "" 2A, E berimental
 Brain esearch, BMD /FGM/ F/FA" fi #WY/` X f2WGA/GGKWGGFF /G/I` WCO` Q,
 8/ i & \$žfi` , \A, 8/ "" #, 4AZA9A,` ; fi` & N A\ABFG/VD84, fi"" / fi ("" fi "" žfi "" 2,
 (" ž` # (, fi # /` # \$` , / fi fi ? ž ž ž fiV` / , fi` , i" / i` ANeuron, , ,MM-MMA