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Reporting Summary

Nature Research wishes to improve the reproducibility of the work that we publish. This form provides structure for consistency and transparency in reporting. For further information on Nature Research policies, see our Editorial Policies and the Editorial Policy Checklist.

Statistics

For all statistical analyses, confirm that the following items are present in the figure legend, table legend, main text, or Methods section.

n/a	Confirmed	
☐	☒	The exact sample size (*n*) for each experimental group/condition, given as a discrete number and unit of measurement
☐	☒	A statement on whether measurements were taken from distinct samples or whether the same sample was measured repeatedly
☐	☒	The statistical test(s) used AND whether they are one- or two-sided *Only common tests should be described solely by name; describe more complex techniques in the Methods section.*
☐	☒	A description of all covariates tested
☐	☒	A description of any assumptions or corrections, such as tests of normality and adjustment for multiple comparisons
☐	☒	A full description of the statistical parameters including central tendency (e.g. means) or other basic estimates (e.g. regression coefficient) AND variation (e.g. standard deviation) or associated estimates of uncertainty (e.g. confidence intervals)
☐	☒	For null hypothesis testing, the test statistic (e.g. *F*, *t*, *r*) with confidence intervals, effect sizes, degrees of freedom and *P* value noted *Give P values as exact values whenever suitable.*
☒	☐	For Bayesian analysis, information on the choice of priors and Markov chain Monte Carlo settings
☒	☐	For hierarchical and complex designs, identification of the appropriate level for tests and full reporting of outcomes
☒	☐	Estimates of effect sizes (e.g. Cohen's *d*, Pearson's *r*), indicating how they were calculated

Our web collection on statistics for biologists contains articles on many of the points above.

Software and code

Policy information about availability of computer code

Data collection	GraphPad Prism 7, FlowJo_V10, Bio-Plex Manager software 5.0, Vectra 3.0 Automated Quantitative Pathology Imaging System, inForm Software 2.4.1, Adobe Photoshop CS6, Microsoft PowerPoint 2016
Data analysis	GraphPad Prism 7 was used to draw graphs and analyze statistical data. FlowJo_V10 was used to analyze flow cytometry data. Bio-Plex Manager software 5.0 was used to calculate the concentrations of 25 cytokines/chemokines in mouse serums. Automated Quantitative Pathology Imaging System and inForm Software 2.4.1 were used to collect immunofluorescence images. Adobe Photoshop CS6 and Microsoft PowerPoint 2016 was used to crop images from unprocessed images.

For manuscripts utilizing custom algorithms or software that are central to the research but not yet described in published literature, software must be made available to editors and reviewers. We strongly encourage code deposition in a community repository (e.g. GitHub). See the Nature Research guidelines for submitting code & software for further information.

Data

Policy information about availability of data

All manuscripts must include a data availability statement. This statement should provide the following information, where applicable:

- Accession codes, unique identifiers, or web links for publicly available datasets
- A list of figures that have associated raw data
- A description of any restrictions on data availability

The source data related to Figs. 1–6 and Supplementary Figs. 1–7 is provided as a Source Data file. The data in Supplementary Fig. 8 used in this study are available in the GEPIA web server database [http://gepia.cancer-pku.cn/detail.php?gene=&clicktag=boxplot]. The data in Supplementary Fig. 9 are available in the TIMER (Tumor IMmune Estimation Resource) database [http://timer.cistrome.org/]. The data in Supplementary Fig. 10 are available in the Kaplan-Meier Plotter database [http://kmplot.com/analysis/index.php?p=service&cancer=liver_rnaseq]. All the other data that support the findings of this study are available within the article, its

Supplementary Information, or from the corresponding author upon reasonable request. A reporting summary for this article is available as a Supplementary Information file.

Field-specific reporting

Please select the one below that is the best fit for your research. If you are not sure, read the appropriate sections before making your selection.

☒ Life sciences ☐ Behavioural & social sciences ☐ Ecological, evolutionary & environmental sciences

For a reference copy of the document with all sections, see nature.com/documents/nr-reporting-summary-flat.pdf

Life sciences study design

All studies must disclose on these points even when the disclosure is negative.

Sample size	Sample sizes for each experiment are stated in figure legends. Sample sizes are determined empirically, and similar in size to most existing studies in the same field (PMID: 20603014, 25818172, 28082402). No statistical method was used to predetermine the sample size. The details of sample size are stated in Figure legends and Methods.
Data exclusions	No data were excluded.
Replication	All experimental findings were replicated independently and reproducible with three times or more.
Randomization	Mice in this study were matched with age and tumor size, and were randomly allocated to the different groups.
Blinding	Collection of animal samples was not blinded, because we needed to count the detailed tumor numbers, tumor volumes or tumor weights of each mouse in different groups. However, data analyzed were blinded.

Behavioural & social sciences study design

All studies must disclose on these points even when the disclosure is negative.

Study description	*Briefly describe the study type including whether data are quantitative, qualitative, or mixed-methods (e.g. qualitative cross-sectional, quantitative experimental, mixed-methods case study).*
Research sample	*State the research sample (e.g. Harvard university undergraduates, villagers in rural India) and provide relevant demographic information (e.g. age, sex) and indicate whether the sample is representative. Provide a rationale for the study sample chosen. For studies involving existing datasets, please describe the dataset and source.*
Sampling strategy	*Describe the sampling procedure (e.g. random, snowball, stratified, convenience). Describe the statistical methods that were used to predetermine sample size OR if no sample-size calculation was performed, describe how sample sizes were chosen and provide a rationale for why these sample sizes are sufficient. For qualitative data, please indicate whether data saturation was considered, and what criteria were used to decide that no further sampling was needed.*
Data collection	*Provide details about the data collection procedure, including the instruments or devices used to record the data (e.g. pen and paper, computer, eye tracker, video or audio equipment) whether anyone was present besides the participant(s) and the researcher, and whether the researcher was blind to experimental condition and/or the study hypothesis during data collection.*
Timing	*Indicate the start and stop dates of data collection. If there is a gap between collection periods, state the dates for each sample cohort.*
Data exclusions	*If no data were excluded from the analyses, state so OR if data were excluded, provide the exact number of exclusions and the rationale behind them, indicating whether exclusion criteria were pre-established.*
Non-participation	*State how many participants dropped out/declined participation and the reason(s) given OR provide response rate OR state that no participants dropped out/declined participation.*
Randomization	*If participants were not allocated into experimental groups, state so OR describe how participants were allocated to groups, and if allocation was not random, describe how covariates were controlled.*

Ecological, evolutionary & environmental sciences study design

All studies must disclose on these points even when the disclosure is negative.

Study description	*Briefly describe the study. For quantitative data include treatment factors and interactions, design structure (e.g. factorial, nested, hierarchical), nature and number of experimental units and replicates.*

Research sample	*Describe the research sample (e.g. a group of tagged Passer domesticus, all Stenocereus thurberi within Organ Pipe Cactus National Monument), and provide a rationale for the sample choice. When relevant, describe the organism taxa, source, sex, age range and any manipulations. State what population the sample is meant to represent when applicable. For studies involving existing datasets, describe the data and its source.*
Sampling strategy	*Note the sampling procedure. Describe the statistical methods that were used to predetermine sample size OR if no sample-size calculation was performed, describe how sample sizes were chosen and provide a rationale for why these sample sizes are sufficient.*
Data collection	*Describe the data collection procedure, including who recorded the data and how.*
Timing and spatial scale	*Indicate the start and stop dates of data collection, noting the frequency and periodicity of sampling and providing a rationale for these choices. If there is a gap between collection periods, state the dates for each sample cohort. Specify the spatial scale from which the data are taken*
Data exclusions	*If no data were excluded from the analyses, state so OR if data were excluded, describe the exclusions and the rationale behind them, indicating whether exclusion criteria were pre-established.*
Reproducibility	*Describe the measures taken to verify the reproducibility of experimental findings. For each experiment, note whether any attempts to repeat the experiment failed OR state that all attempts to repeat the experiment were successful.*
Randomization	*Describe how samples/organisms/participants were allocated into groups. If allocation was not random, describe how covariates were controlled. If this is not relevant to your study, explain why.*
Blinding	*Describe the extent of blinding used during data acquisition and analysis. If blinding was not possible, describe why OR explain why blinding was not relevant to your study.*

Did the study involve field work? ☐ Yes ☐ No

Field work, collection and transport

Field conditions	*Describe the study conditions for field work, providing relevant parameters (e.g. temperature, rainfall).*
Location	*State the location of the sampling or experiment, providing relevant parameters (e.g. latitude and longitude, elevation, water depth).*
Access & import/export	*Describe the efforts you have made to access habitats and to collect and import/export your samples in a responsible manner and in compliance with local, national and international laws, noting any permits that were obtained (give the name of the issuing authority, the date of issue, and any identifying information).*
Disturbance	*Describe any disturbance caused by the study and how it was minimized.*

Reporting for specific materials, systems and methods

We require information from authors about some types of materials, experimental systems and methods used in many studies. Here, indicate whether each material, system or method listed is relevant to your study. If you are not sure if a list item applies to your research, read the appropriate section before selecting a response.

Materials & experimental systems

n/a	Involved in the study
☐	☒ Antibodies
☐	☒ Eukaryotic cell lines
☒	☐ Palaeontology and archaeology
☐	☒ Animals and other organisms
☒	☐ Human research participants
☒	☐ Clinical data
☒	☐ Dual use research of concern

Methods

n/a	Involved in the study
☒	☐ ChIP-seq
☐	☒ Flow cytometry
☒	☐ MRI-based neuroimaging

Antibodies

Antibodies used	InVivoMab anti-mouse CD8 (53-6.7), BioXcell, BE0004-1, 200µg/mice. InVivoMab anti-mouse CD4 (GK1.5), BioXcell, BE0003-1, 200µg/mice. Clophosome-Clodronate Liposomes (Neutral), FormuMax, F70101C-N, 0.1 mL for 20-25g body weight. InVivoMab anti-mouse LY6G (1A8), BioXcell, BE0075-1, 200µg/mice. InVivoMAb anti-mouse NK1.1 (PK136), BioXcell, BE0036, 200µg/mice. InVivoMab anti-mouse CCL2 (2H5), BioXcell, BE0185, 200µg/mice. InVivoMab anti-mouse PD-L1 (10F.9G2), BioXcell, BE0101, 100 or 200µg/mice. InVivoMAb rat IgG2a isotype control, anti-trinitrophenol, BioXcell, BE0089, 100 or 200µg/mice. InVivoMAb rat IgG2b isotype control, anti-keyhole limpet hemocyanin, BioXcell, BE0090, 100 or 200µg/mice.

InVivoMAb polyclonal Armenian hamster IgG, BioXcell, BE0091, 100 or 200μg/mice.

Fixable Viability Stain 510, BD Pharmingen, 564406, 1:500.
Ms CD16/CD32 Pure, BD Pharmingen, 553141, 1:50.
Ms CD45 APC-Cy7, BD Pharmingen, 557659, 1:200.
Ms CD3e PerCP-Cy5.5, BD Pharmingen, 551163, 1:200.
Ms CD4 FITC, BD Pharmingen, 553046, 1:200.
Ms CD8a BV421, BD Pharmingen, 563898, 1:200.
Ms CD11B BV421,BD Pharmingen, 562605, 1:200.
Ms F4/80 PE, BD Pharmingen, 565410, 1:200.
Ms CD206 FITC, Biolegend, 141704, 1:200.
Ms Ly-6G/Ly-6C FITC, BD Pharmingen, 553127, 1:200.
Ms Ly-6G PerCP-Cy5.5, BD Pharmingen, 560602, 1:200.
Ms Ly-6C PE-Cy7, BD Pharmingen , 560593, 1:200.
Ms NK-1.1 PE, BD Pharmingen, 553165, 1:200.

Rabbit Anti-CD45 antibody, Abcam, ab10558, 1:800.
Rabbit Anti-CD8 antibody, Abcam , ab203035, 1:500.
Rabbit Anti-F4/80 antibody, Abcam, ab100790, 1:500.
Rabbit Anti-Ly6C antibody, Abcam, ab15627, 1:500.
Rabbit Anti-Ly6G antibody, Abcam, ab25377, 1:500.
Rabbit Anti-MCP1 antibody, Abcam, ab25124, 1:500.
Rabbit Anti-ADRB1 Polyclonal Antibody, Absin, abs119982a, 1:1000.
Rabbit Anti-ADRB2 Polyclonal Antibody, Absin, abs120301a, 1:1000.
Rabbit Anti-ADRB3 Polyclonal Antibody,Absin, abs120618a, 1:1000.
Anti-MCP1 antibody, Abcam, ab9899, 1:500.
GAPDH (14C10) Rabbit mAb, Cell Signaling Technology, 2118L, 1:1000.

Validation

All antibodies were commercially available and validated by manufacturer's or published stidies.
InVivoMab anti-mouse CD8 (53-6.7): https://bxcell.com/product/m-cd8a/, PMID: 30423296.
InVivoMab anti-mouse CD4 (GK1.5): https://bxcell.com/product/m-cd4/, PMID: 27775706.
Clophosome-Clodronate Liposomes (Neutral): https://www.liposomeexpert.com/clophosome-clodronate-liposomes/clophosome-clodronate-liposomes-neutral/, PMID: 32179631.
InVivoMab anti-mouse LY6G (1A8): https://bxcell.com/product/invivomab-anti-m-ly-6g/, PMID: 27775706.
InVivoMAb anti-mouse NK1.1 (PK136): https://bxcell.com/product/nk-1-1/, PMID: 29329948.
InVivoMab anti-mouse CCL2 (2H5): https://bxcell.com/product/m-r-h-ccl2-mcp-1/, PMID: 25252955.
InVivoMab anti-mouse PD-L1 (10F.9G2): https://bxcell.com/product/m-pdl-1/, PMID: 30054205.
InVivoMAb rat IgG2a isotype control, anti-trinitrophenol: https://bxcell.com/product/rat-igg2a-isotype-control/, PMID: 30097293.
InVivoMAb rat IgG2b isotype control, anti-keyhole limpet hemocyanin: https://bxcell.com/product/rat-igg2b-isotype-control/, PMID: 30097293.
InVivoMAb polyclonal Armenian hamster IgG: https://bxcell.com/product/polyclonal-3/, PMID: 29339377.

Fixable Viability Stain 510: https://www.bdbiosciences.com/zh-cn/products/reagents/flow-cytometry-reagents/research-reagents/single-color-antibodies-ruo/fixable-viability-stain-510.564406
Ms CD16/CD32 Pure: https://www.bdbiosciences.com/zh-cn/products/reagents/flow-cytometry-reagents/research-reagents/single-color-antibodies-ruo/purified-rat-anti-mouse-cd16-cd32-mouse-bd-fc-block.553141
Ms CD45 APC-Cy7: https://www.bdbiosciences.com/zh-cn/products/reagents/flow-cytometry-reagents/research-reagents/single-color-antibodies-ruo/apc-cy-7-rat-anti-mouse-cd45.557659
Ms CD3e PerCP-Cy5.5: https://www.bdbiosciences.com/zh-cn/products/reagents/flow-cytometry-reagents/research-reagents/single-color-antibodies-ruo/percp-cy-5-5-hamster-anti-mouse-cd3e.551163
Ms CD4 FITC: https://www.bdbiosciences.com/zh-cn/products/reagents/flow-cytometry-reagents/research-reagents/single-color-antibodies-ruo/fitc-rat-anti-mouse-cd4.553046
Ms CD8a BV421:https://www.bdbiosciences.com/zh-cn/products/reagents/flow-cytometry-reagents/research-reagents/single-color-antibodies-ruo/bv421-rat-anti-mouse-cd8a.563898
Ms CD11B BV421: https://www.bdbiosciences.com/zh-cn/products/reagents/flow-cytometry-reagents/research-reagents/single-color-antibodies-ruo/bv421-rat-anti-cd11b.562605
Ms F4/80 PE: https://www.bdbiosciences.com/zh-cn/products/reagents/flow-cytometry-reagents/research-reagents/single-color-antibodies-ruo/pe-rat-anti-mouse-f4-80.565410
Ms CD206 FITC: https://www.biolegend.com/en-us/products/fitc-anti-mouse-cd206-mmr-antibody-7318
Ms Ly-6G/Ly-6C FITC: https://www.bdbiosciences.com/zh-cn/search-results?searchKey=553127
Ms Ly-6G PerCP-Cy5.5: https://www.bdbiosciences.com/zh-cn/products/reagents/flow-cytometry-reagents/research-reagents/single-color-antibodies-ruo/percp-cy-5-5-rat-anti-mouse-ly-6g.560602
Ms Ly-6C PE-Cy7: https://www.bdbiosciences.com/zh-cn/products/reagents/flow-cytometry-reagents/research-reagents/single-color-antibodies-ruo/pe-cy-7-rat-anti-mouse-ly-6c.560593
Ms NK-1.1 PE: https://www.bdbiosciences.com/zh-cn/products/reagents/flow-cytometry-reagents/research-reagents/single-color-antibodies-ruo/pe-mouse-anti-mouse-nk-1-1.553165

Rabbit Anti-CD45 antibody: https://www.abcam.cn/cd45-antibody-ab10558.html, PMID: 32494593.
Rabbit Anti-CD8 antibody: PMID: 32690772.
Rabbit Anti-F4/80 antibody: https://www.abcam.cn/f480-antibody-ab100790.html, PMID: 32754258.

Rabbit Anti-Ly6C antibody: https://www.abcam.cn/ly6c-antibody-er-mp20-ab15627.html, PMID: 31295147.
Rabbit Anti-Ly6G antibody: https://www.abcam.cn/ly6g-antibody-rb6-8c5-ab25377.html, PMID: 31525266.
Rabbit Anti-MCP1 antibody: https://www.abcam.cn/mcp1-antibody-ab25124.html, PMID: 32064233.
Rabbit Anti-ADRB1 Polyclonal Antibody: https://www.absin.cn/rabbit-anti-adrb1-polyclonal-antibody/abs119982.html
Rabbit Anti-ADRB2 Polyclonal Antibody: https://www.absin.cn/rabbit-anti-adrb2-polyclonal-antibody/abs120301.html
Rabbit Anti-ADRB3 Polyclonal Antibody: https://www.absin.cn/rabbit-anti-beta-3-adrenergic-receptor-polyclonal-antibody/abs120618.html.
Anti-MCP1 antibody: https://www.abcam.cn/mcp1-antibody-ab9899.html, PMID: 32641688.
GAPDH (14C10) Rabbit mAb: https://www.cellsignal.cn/products/primary-antibodies/gapdh-14c10-rabbit-mab/2118?site-search-type=Products&N=4294956287&Ntt=2118&fromPage=plp&_requestid=3007039, PMID: 34190686.

Eukaryotic cell lines

Policy information about cell lines

Cell line source(s)	All murine liver cancer cell lines were purchased from ATCC, including Hepa1-6, LPC-H12 and H22. Human hepatocytes/ hepatic stellate cells organoid were obtained from the Ding's Laboratory, SINH,SIBS CAS.
Authentication	The cell lines obtained from ATCC with responsive authentication and characterization.
Mycoplasma contamination	All the cell lines used in this study was tested negative for mycoplasma contamination.
Commonly misidentified lines (See ICLAC register)	None

Palaeontology and Archaeology

Specimen provenance	*Provide provenance information for specimens and describe permits that were obtained for the work (including the name of the issuing authority, the date of issue, and any identifying information).*
Specimen deposition	*Indicate where the specimens have been deposited to permit free access by other researchers.*
Dating methods	*If new dates are provided, describe how they were obtained (e.g. collection, storage, sample pretreatment and measurement), where they were obtained (i.e. lab name), the calibration program and the protocol for quality assurance OR state that no new dates are provided.*

☐ Tick this box to confirm that the raw and calibrated dates are available in the paper or in Supplementary Information.

Ethics oversight	*Identify the organization(s) that approved or provided guidance on the study protocol, OR state that no ethical approval or guidance was required and explain why not.*

Note that full information on the approval of the study protocol must also be provided in the manuscript.

Animals and other organisms

Policy information about studies involving animals; ARRIVE guidelines recommended for reporting animal research

Laboratory animals	C57BL/6 (male, 2-3 weeks age) and BALB/c mice (male, 3 weeks age) were obtained from Shanghai Slac Laboratory Animal Co. and fed in a pathogen-free vivarium under standard conditions (temperature, around 22ど ; relative humidity, 40-70% and a 12-hour light-dark cycle). CCL2-/- and CCR2-/- mice on C57BL/6 background were obtained from the Jackson Laboratory.
Wild animals	None
Field-collected samples	The study did not involve field-collected samples
Ethics oversight	Animal protocols were performed in agreement with the SIBS Guide for Care and Use of Laboratory Animals and approved by the Animal Care and Use Committee of Institute for Nutritional and Health, SIBS, CAS.

Note that full information on the approval of the study protocol must also be provided in the manuscript.

Human research participants

Policy information about studies involving human research participants

Population characteristics	*Describe the covariate-relevant population characteristics of the human research participants (e.g. age, gender, genotypic information, past and current diagnosis and treatment categories). If you filled out the behavioural & social sciences study design questions and have nothing to add here, write "See above."*
Recruitment	*Describe how participants were recruited. Outline any potential self-selection bias or other biases that may be present and how these are likely to impact results.*

Ethics oversight | *Identify the organization(s) that approved the study protocol.*

Note that full information on the approval of the study protocol must also be provided in the manuscript.

Clinical data

Policy information about clinical studies

All manuscripts should comply with the ICMJE guidelines for publication of clinical research and a completed CONSORT checklist must be included with all submissions.

Clinical trial registration	*Provide the trial registration number from ClinicalTrials.gov or an equivalent agency.*
Study protocol	*Note where the full trial protocol can be accessed OR if not available, explain why.*
Data collection	*Describe the settings and locales of data collection, noting the time periods of recruitment and data collection.*
Outcomes	*Describe how you pre-defined primary and secondary outcome measures and how you assessed these measures.*

Dual use research of concern

Policy information about dual use research of concern

Hazards

Could the accidental, deliberate or reckless misuse of agents or technologies generated in the work, or the application of information presented in the manuscript, pose a threat to:

No	Yes	
☐	☐	Public health
☐	☐	National security
☐	☐	Crops and/or livestock
☐	☐	Ecosystems
☐	☐	Any other significant area

Experiments of concern

Does the work involve any of these experiments of concern:

No	Yes	
☐	☐	Demonstrate how to render a vaccine ineffective
☐	☐	Confer resistance to therapeutically useful antibiotics or antiviral agents
☐	☐	Enhance the virulence of a pathogen or render a nonpathogen virulent
☐	☐	Increase transmissibility of a pathogen
☐	☐	Alter the host range of a pathogen
☐	☐	Enable evasion of diagnostic/detection modalities
☐	☐	Enable the weaponization of a biological agent or toxin
☐	☐	Any other potentially harmful combination of experiments and agents

ChIP-seq

Data deposition

☐ Confirm that both raw and final processed data have been deposited in a public database such as GEO.

☐ Confirm that you have deposited or provided access to graph files (e.g. BED files) for the called peaks.

Data access links *May remain private before publication.*	*For "Initial submission" or "Revised version" documents, provide reviewer access links. For your "Final submission" document, provide a link to the deposited data.*
Files in database submission	*Provide a list of all files available in the database submission.*
Genome browser session (e.g. UCSC)	*Provide a link to an anonymized genome browser session for "Initial submission" and "Revised version" documents only, to enable peer review. Write "no longer applicable" for "Final submission" documents.*

Methodology

Replicates	*Describe the experimental replicates, specifying number, type and replicate agreement.*
Sequencing depth	*Describe the sequencing depth for each experiment, providing the total number of reads, uniquely mapped reads, length of reads and whether they were paired- or single-end.*
Antibodies	*Describe the antibodies used for the ChIP-seq experiments; as applicable, provide supplier name, catalog number, clone name, and lot number.*
Peak calling parameters	*Specify the command line program and parameters used for read mapping and peak calling, including the ChIP, control and index files used.*
Data quality	*Describe the methods used to ensure data quality in full detail, including how many peaks are at FDR 5% and above 5-fold enrichment.*
Software	*Describe the software used to collect and analyze the ChIP-seq data. For custom code that has been deposited into a community repository, provide accession details.*

Flow Cytometry

Plots

Confirm that:

☒ The axis labels state the marker and fluorochrome used (e.g. CD4-FITC).

☒ The axis scales are clearly visible. Include numbers along axes only for bottom left plot of group (a 'group' is an analysis of identical markers).

☒ All plots are contour plots with outliers or pseudocolor plots.

☒ A numerical value for number of cells or percentage (with statistics) is provided.

Methodology

Sample preparation	Fresh mouse tumor tissues were harvested, minced, and digested into single cell with mouse tumor dissociation kits (Miltenyi Biotech) according to the manufacturer's instructions. First, the single-cell suspensions were centrifuged and suspended in stain buffer (BD Pharmingen) after removal of red blood cells, and then incubated with Fixable viability stain 510 (BD Pharmingen) to exclude the dead cells. Second, cells were incubated with the anti-mouse CD16/32 antibody (BD Pharmingen) for 15 min to prevent non-specific binding. After this step, cells were stained with all relevant antibodies for 1 h at room temperature away from the light. Then cells were washed twice with PBS and re-suspended in 200 µL stain buffer. Last, single-cell suspensions were analyzed by BD FACS Aria▫ or Beckman Moflo Astrios.
Instrument	BD FACS Aria ▫ , Beckman Moflo Astrios
Software	FlowJo_V10
Cell population abundance	Physical parameter and Fixable Viability Stain 510 (BD Pharmingen) was used to exclude the dead cells. Positive populations were defined using not stained cells as reference. Isotype controls were used to confirm the specificity of the staining. In some experiments, the percentage of the relevant cell populations is shown in figures.
Gating strategy	CD8+ T cells (Live+CD45+CD3e+CD8+), CD4+ T cells (Live+CD45+CD3e+CD4+), M1-TAMs (Live+CD45+Ly6G-CD11b+F4/80 +CD206-), M2-TAMs (Live+CD45+Ly6G-CD11b+F4/80+CD206+), G-MDSCs (Live+CD45+CD11b+Ly6G+), M-MDSCs (Live+CD45 +CD11b+Ly6C+), and NK cells (Live+CD45+CD3e-NK1.1+).

☒ Tick this box to confirm that a figure exemplifying the gating strategy is provided in the Supplementary Information.

Magnetic resonance imaging

Experimental design

Design type	*Indicate task or resting state; event-related or block design.*
Design specifications	*Specify the number of blocks, trials or experimental units per session and/or subject, and specify the length of each trial or block (if trials are blocked) and interval between trials.*
Behavioral performance measures	*State number and/or type of variables recorded (e.g. correct button press, response time) and what statistics were used to establish that the subjects were performing the task as expected (e.g. mean, range, and/or standard deviation across subjects).*

Acquisition

Imaging type(s) *Specify: functional, structural, diffusion, perfusion.*

Field strength *Specify in Tesla*

Sequence & imaging parameters *Specify the pulse sequence type (gradient echo, spin echo, etc.), imaging type (EPI, spiral, etc.), field of view, matrix size, slice thickness, orientation and TE/TR/flip angle.*

Area of acquisition *State whether a whole brain scan was used OR define the area of acquisition, describing how the region was determined.*

Diffusion MRI ☐ Used ☐ Not used

Preprocessing

Preprocessing software *Provide detail on software version and revision number and on specific parameters (model/functions, brain extraction, segmentation, smoothing kernel size, etc.).*

Normalization *If data were normalized/standardized, describe the approach(es): specify linear or non-linear and define image types used for transformation OR indicate that data were not normalized and explain rationale for lack of normalization.*

Normalization template *Describe the template used for normalization/transformation, specifying subject space or group standardized space (e.g. original Talairach, MNI305, ICBM152) OR indicate that the data were not normalized.*

Noise and artifact removal *Describe your procedure(s) for artifact and structured noise removal, specifying motion parameters, tissue signals and physiological signals (heart rate, respiration).*

Volume censoring *Define your software and/or method and criteria for volume censoring, and state the extent of such censoring.*

Statistical modeling & inference

Model type and settings *Specify type (mass univariate, multivariate, RSA, predictive, etc.) and describe essential details of the model at the first and second levels (e.g. fixed, random or mixed effects; drift or auto-correlation).*

Effect(s) tested *Define precise effect in terms of the task or stimulus conditions instead of psychological concepts and indicate whether ANOVA or factorial designs were used.*

Specify type of analysis: ☐ Whole brain ☐ ROI-based ☐ Both

Statistic type for inference (See Eklund et al. 2016) *Specify voxel-wise or cluster-wise and report all relevant parameters for cluster-wise methods.*

Correction *Describe the type of correction and how it is obtained for multiple comparisons (e.g. FWE, FDR, permutation or Monte Carlo).*

Models & analysis

n/a	Involved in the study
☐	☐ Functional and/or effective connectivity
☐	☐ Graph analysis
☐	☐ Multivariate modeling or predictive analysis

Functional and/or effective connectivity *Report the measures of dependence used and the model details (e.g. Pearson correlation, partial correlation, mutual information).*

Graph analysis *Report the dependent variable and connectivity measure, specifying weighted graph or binarized graph, subject- or group-level, and the global and/or node summaries used (e.g. clustering coefficient, efficiency, etc.).*

Multivariate modeling and predictive analysis *Specify independent variables, features extraction and dimension reduction, model, training and evaluation metrics.*