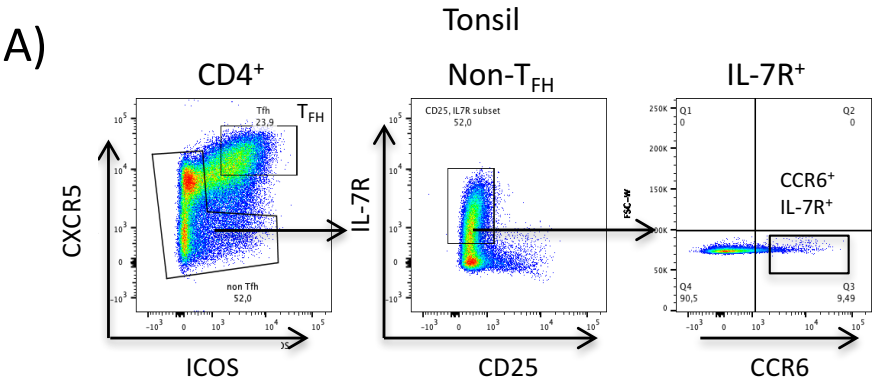
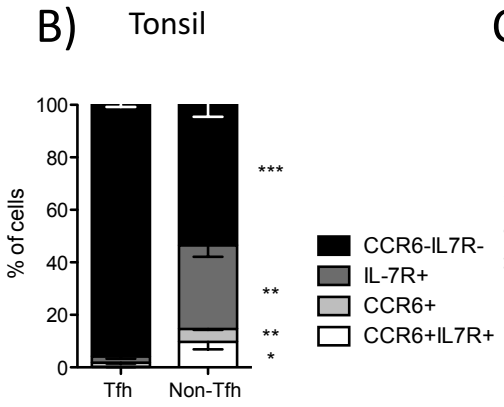
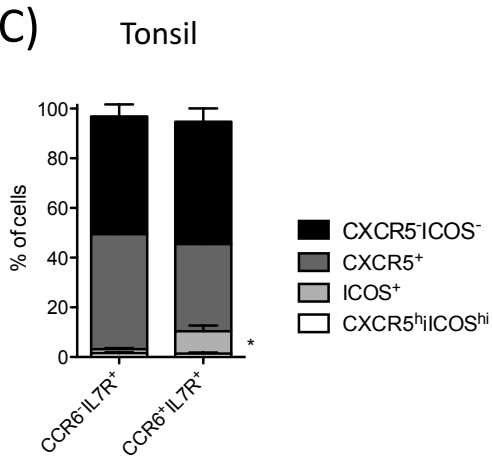
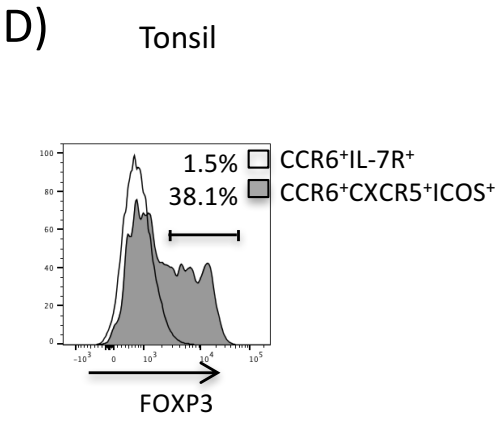
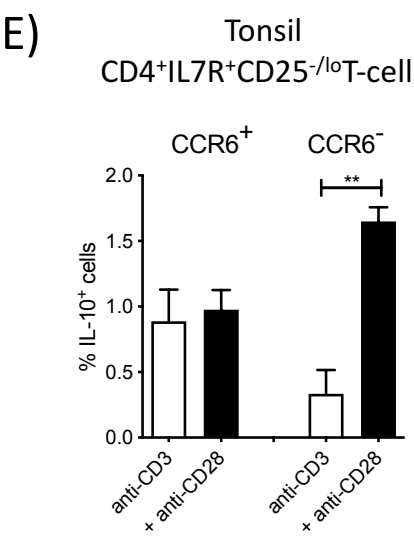
Supplementary Figure 1:
Gating strategy and properties of T_{FH} and CCR6⁺IL7R⁺ T-cells

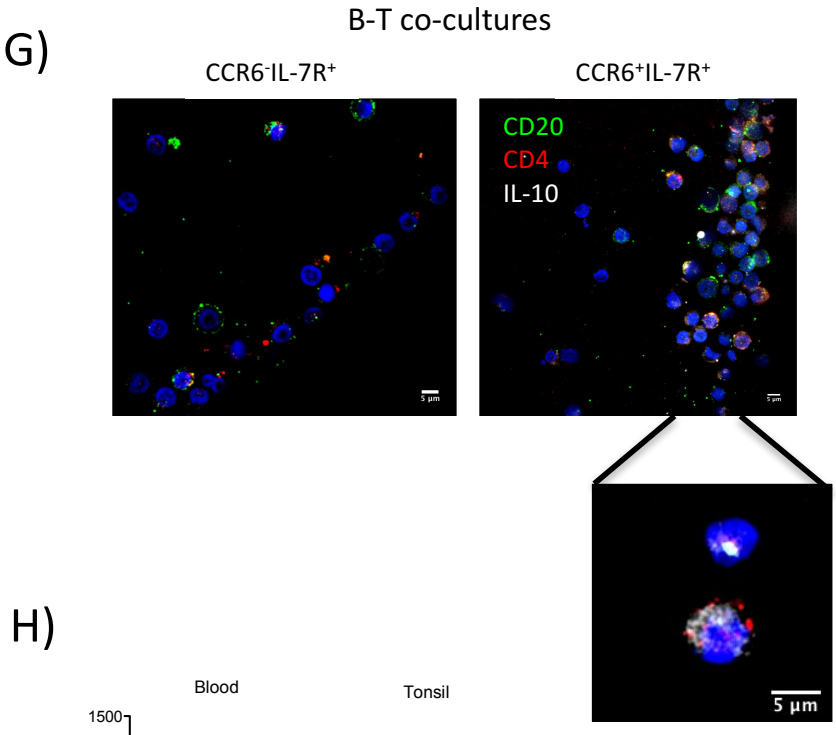


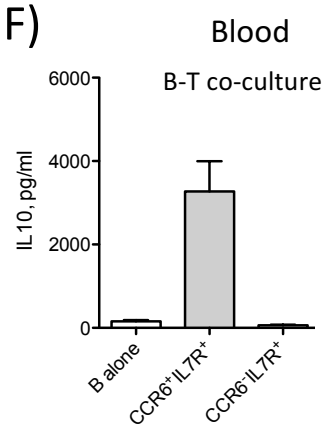


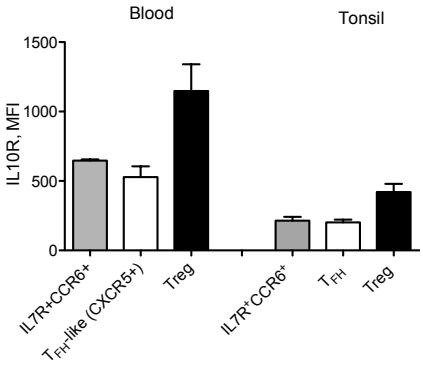






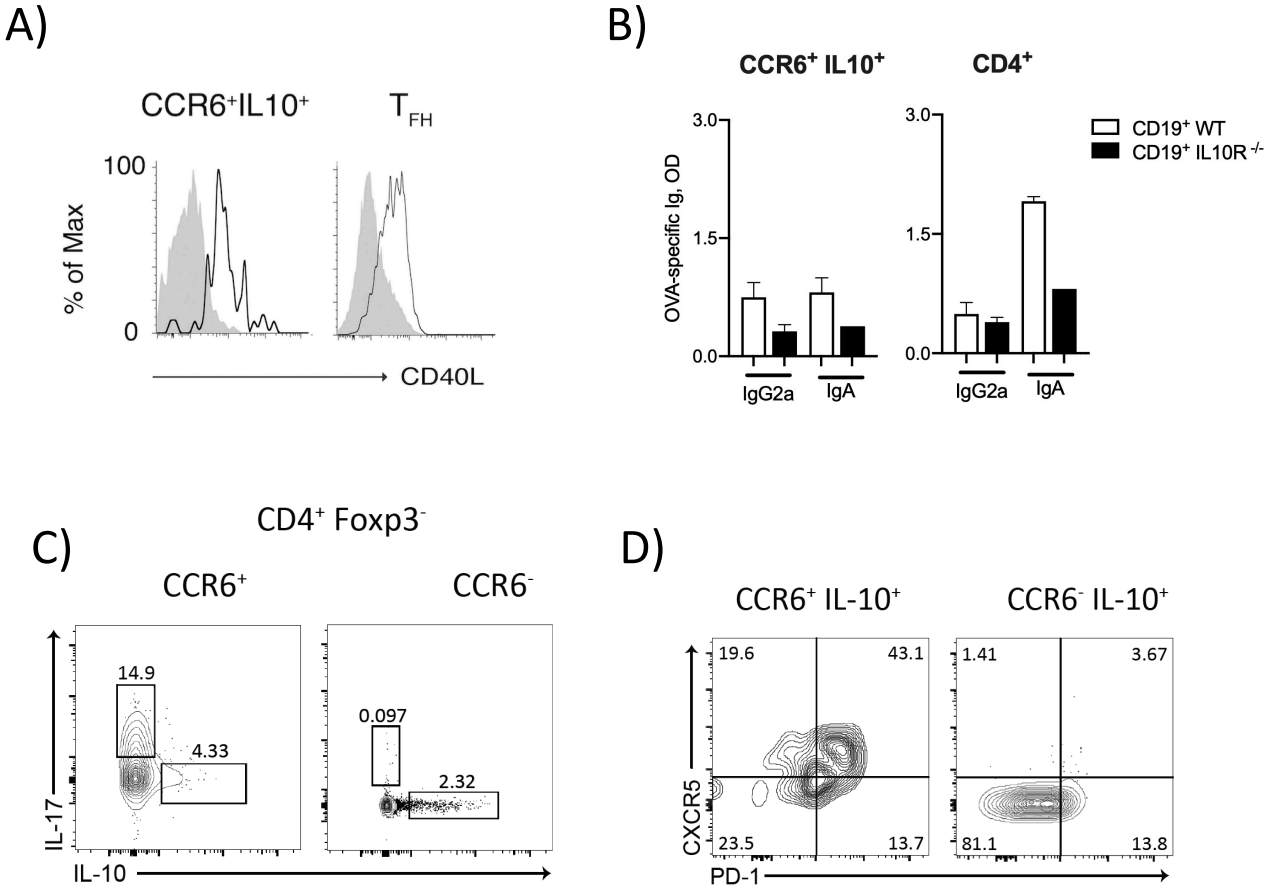






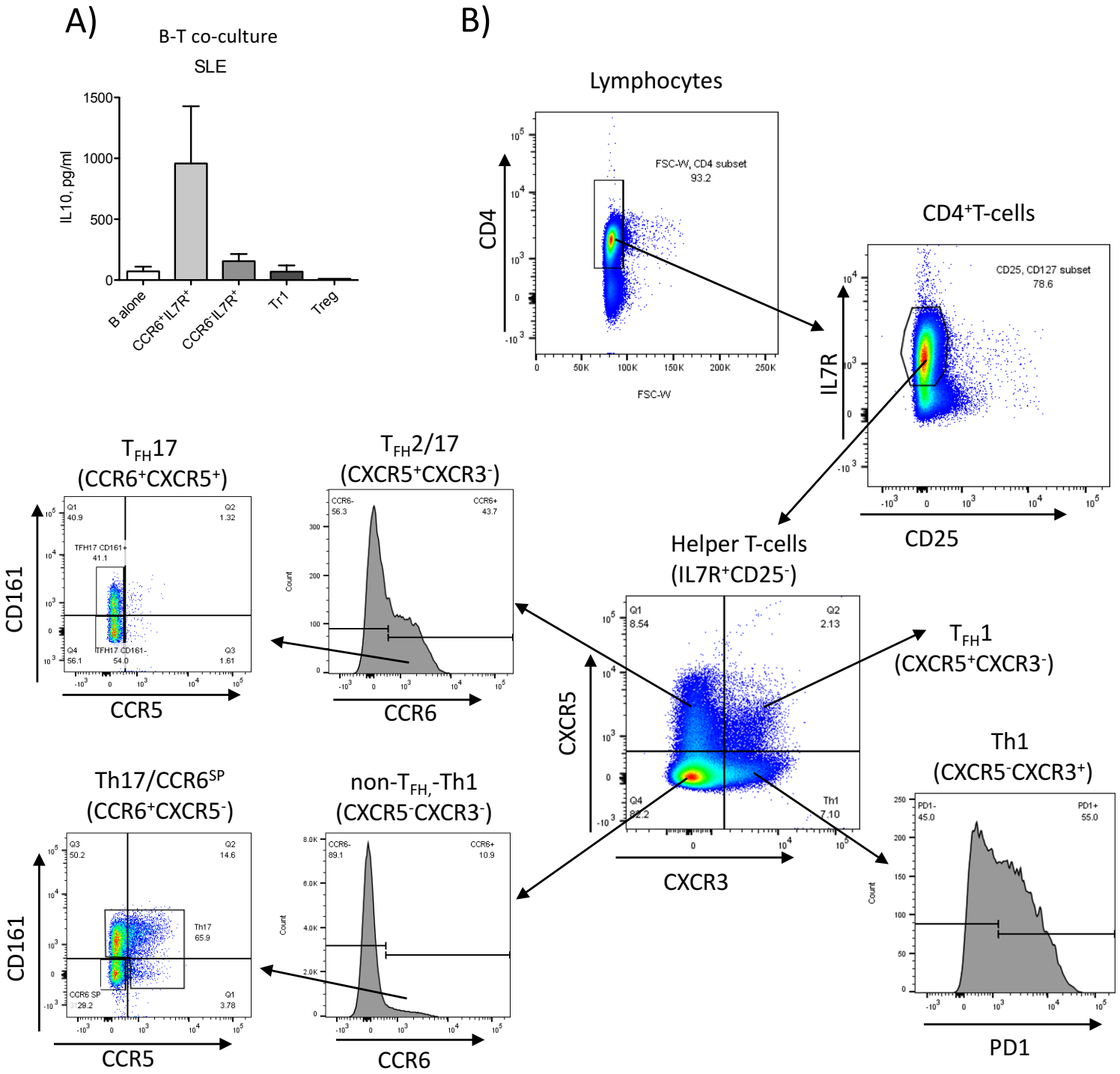
Supplementary Figure 1: **A)** Gating strategy for $CXCR5^+ICOS^+T_{FH}$-cells and $CCR6^+IL7R^{hi}CD25^{lo/-}$-T-cells in human tonsils. Mean percentages **B)** of CCR6 and IL7R expression among $CXCR5^+ICOS^+T_{FH}$ and non-T_{FH}-cells and **C)** of CXCR5 and ICOS expression among tonsillar $CCR6^+IL7R^+$ and $CCR6^-IL7R^+$T-cells, n=5, *,**,*** indicate statistical significances between T_{FH} and non-T_{FH} or $CCR6^+IL7R^+$ and $CCR6^-IL7R^+$T-cells, respectively. **D)** FOXP3 expression in $CCR6^+IL7R^+$T-cells (open Histogram) and in $CCR6^+ICOS^+CXCR5^+$T-cells (grey Histogram) in a representative tonsil. Numbers indicate percentages of $FOXP3^+$ cells. **E)** IL-10 production by tonsillar $CCR6^+$ and $CCR6^-IL7R^+$T-cells following 30 hours of anti-CD3 stimulation in the absence or presence of CD28 co-stimulation (n=4) **F)** IL-10 concentrations in d6 supernatants of naïve B-cells alone or together with autologous, circulating $CCR6^+IL7R^+$ or $CCR6^-IL7R^+$T-cells and SEB (n=5). **G)** Immunofluorescence of IL-10 (white) in $CD4^+$T-cells (red) in co-cultures of naïve B-cells (green) and $CCR6^-IL7R^+$T-cells (left) or $CCR6^+IL7R^+$T-cells (right). Two $IL\text{-}10^{hi}CCR6^+$T-cells are shown in higher magnification (right).
H) Mean *ex vivo* IL-10R expression on $CCR6^+IL7R^+$ and $CXCR5^+T_{FH}$-like cells in peripheral blood or $CCR6^+IL7R^+$ and $CXCR5^+ICOS^+T_{FH}$ in tonsils (n=4). $CD25^+IL7R^{lo}$Tregs are shown as positive control.

Supplementary Figure 2:
Characteristics of murine IL-10+CCR6+T-cells from spleens



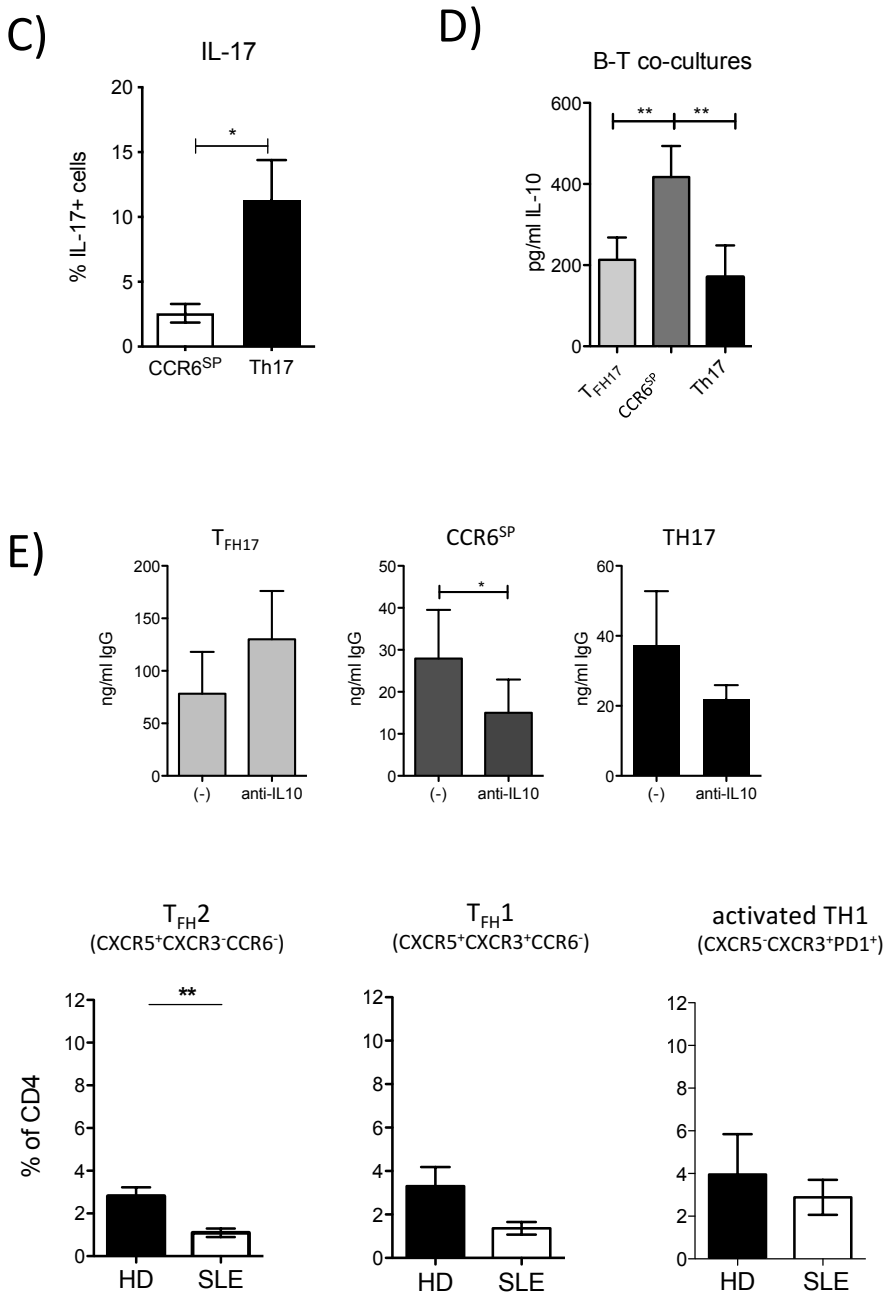
Supplementary Figure 2: **A)** CD40L expression by splenic TFH-cells and $CCR6^+IL\text{-}10^+$T-cells isolated from anti-CD3 injected FirxTiger mice. **B)** Serum levels of IgG2A and IgA following co-transfer of $CCR6^+IL\text{-}10^+$OTII T-cells and either wildtyoe B-cells (open Bars) or $IL10R^{DN}$ B-cells (filled black Bars) after 12 days following OVA vaccination (n=3). **C)** Representative IL-17 versus IL-10 reporter expression in gated $CD4^+FOXP3^-$ T-cells according to CCR6 expression in triple reporter mice with lupus-like disease **D)** Representative CXCR5 and PD1 co-stainings of splenic $CD4^+FOXP3^-IL10^+$T-cells according to CCR6 expression in mice with lupus-like disease.

Supplementary Figure 3 (A/B):
T-cell subsets and cytokines in SLE patients



Supplementary Figure 3: **A)** IL-10 concentrations in d6 culture supernatants of B-cells from SLE patients alone or together with autologous CCR6+IL7R+ or CCR6-IL7R+T-c.ells and SEB (n=5) **B)** Gating strategy for T-cell subsets in human blood: Helper T-cells were gated as $CD4^{+}IL7R^{+}CD25^{lo/-}$ cells. Based on the expression of CXCR5, CXCR3 and, among CXCR3- cells, CCR6, they were further subdivided into Th1, T_{FH1}, T_{FH2} or T_{FH17}cells. Th1-cells were further analyzed for PD1 to track "activated" Th1-cells; in this case $IL\text{-}7R^{-}CD25^{-}$ cells were not excluded (1). Finally, $CCR6^{+}CXCR3^{-}IL7R^{+}$ helper cells were further analyzed according to CD161 and CCR5 expression, and $CCR6^{+}CXCR5^{-}$ cells defined as either Th17-cells ($CD161^{+}$ or $CCR5^{+}$) or as "$CCR6^{SP}$"-T-cells ($CD161^{-}$ and $CCR5^{-}$).

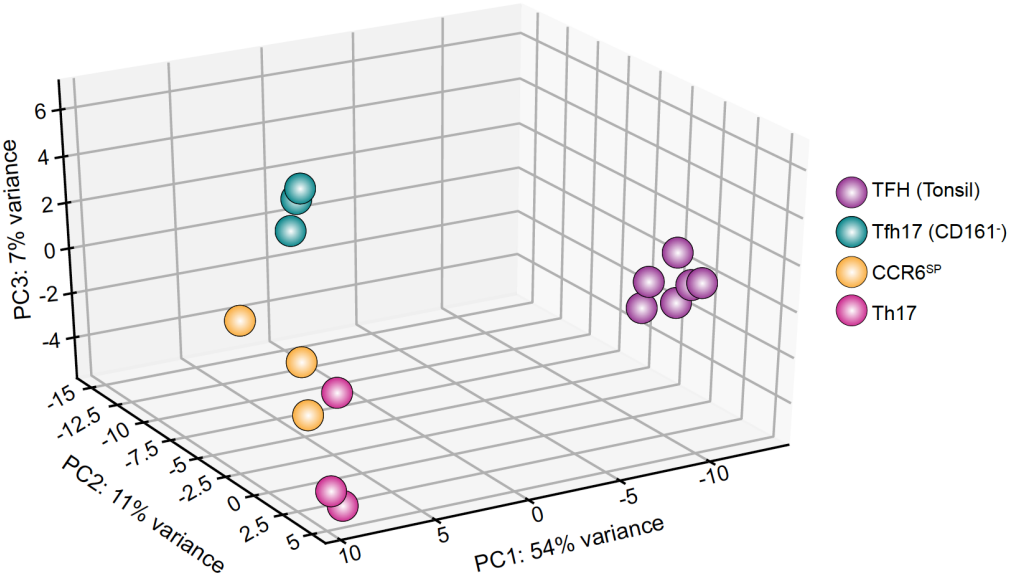
Supplementary Figure 3 (C-F):
T-cell subsets and cytokines in SLE patients



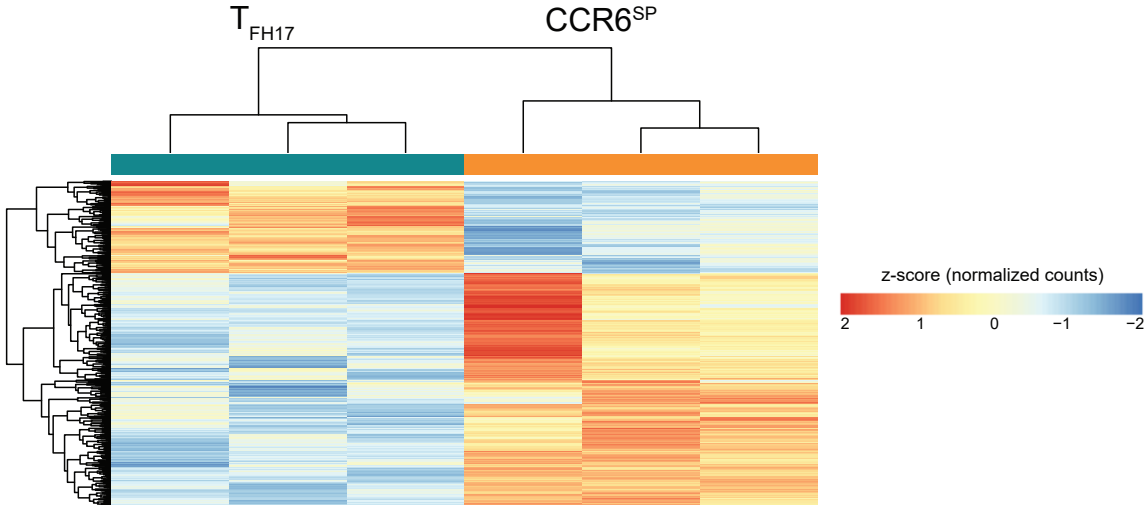
Supplementary Figure 3: **C)** IL-17 production of purified Th17-cells and CCR6^{SP}T-cells from healthy donors after brief stimulation with PMA and Ionomycin (n=5). **D)** IL-10 and **E)** IgG concentrations were measured by ELISA in d8 culture supernatants of naive B-cells co-cultured with the indicated autologous CCR6^{+}IL7R^{+}T-cell subsets from healthy donors in the presence of SEB (n=5) **F)** Frequencies of other SLE-relevant T-cell subsets (T_{FH1}, T_{FH2} and PD1^{+}Th1-cells (CXCR3^{+}CXCR5^{-}) in peripheral blood of healthy donors (n>6) and SLE patients (n>5).

Supplementary Figure 4:
Gene expression analysis of CCR6^{SP}T-cells

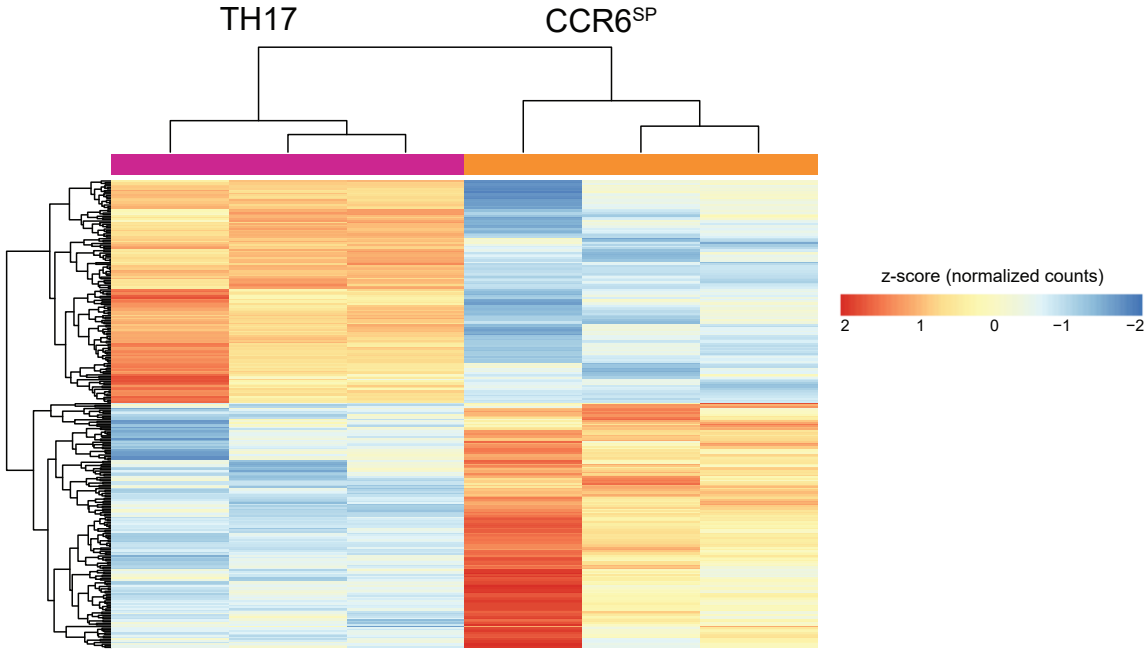
A)



B)



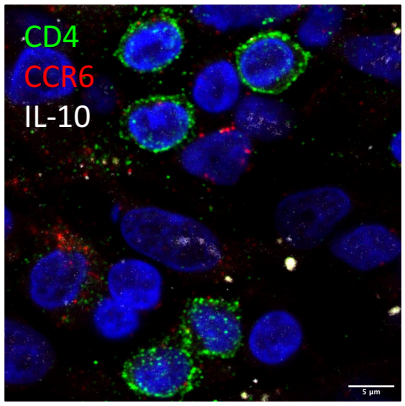
C)



Supplementary Figure 4: **A)** Principal component analysis of tonsillar T_{FH}-, circulating T_{FH17}-like, CCR6^{SP}- and Th17-cells. **B/C)** Heatmaps of differentially expressed genes in CCR6^{SP}T-cells as compared to **B)** CD161-T_{FH17}-cells (Genes are listed in Dataset S2) and **C)** to Th17-cells (Genes are listed in Dataset S3)

Supplementary Figure 5:
Lack of $CR6^{+}IL10^{+}$T-cells in human control lymph nodes

non-SLE lymph node



Supplementary Figure 5:
A representative confocal image of a control lymph node illustrating the absence of $CD4^{+}CCR6^{+}IL10^{+}$T-cells.

sTable 1. Demographic, laboratory and clinical characteristics of patients with SLE

Characteristics	(n=37)
Demographic characteristics	
Female/Male, n	37/5
Age, years, median (IQR)	44 (38-49)
Disease duration, years, median (IQR)	19 (11-26)
Laboratory tests	
ANA positivity	97%
anti-ENA positivity	49%
anti-SSA/Ro	41%
anti-Sm/RNP	16%
anti-RNP	5%
*anti-dsDNA positivity, n (%)	46%
medium/high titre	41%
LA	27%
ᶜanti-bG2PI IgG	13%
ᶜanti-CL IgG	24%
°Hypocomplementemia	49%
Positive Coombs test	13%
Urinary proteins 24 h >500 mg/24	13%
Haemoglobin levels, g/dL, median (IQR)	12.9 (11.7-13.9)
White blood cells, number of cells per mm^3, median (IQR)	6,200 (4,400-7,800)
Neutrophils	4,300 (2,900-5,800)
Lymphocytes	1,500 (1,000-2,000)
Platelets, number of cells per mm^3, median (IQR)	225,000 (180,000-283,000)
Disease activity and clinical manifestations	
§SLEDAI-2K, median (min-max)	3.5 (0-24)
Moderate/high activity	19%
^BILAG-2004 numerical score, median (min-max)	1 (1-36)
Moderate/high activity	30%
constitutional	57%
mucocutaneous	13%
neuropsychiatric	5%
musculoskeletal	16%
cardiorespiratory	11%
gastrointestinal	0%
ophthalmic	0%
renal	16%
haematological	19%
Ongoing therapy	
Equivalent prednisone dose mg/day, median (IQR)	5 (2.5-15)
Ongoing DMARDs	
hydroxychloroquine	68%
mycophenolate mofetil	24%
azathioprine	16%
methotrexate	8%
cyclosporine	5%
tacrolimus	5%
rituximab	3%
OAT	16%
LDA	32%

anti-CL: anticardiolipin, anti-b2GPI: anti-b2glycoprotein I, ANA: anti-nuclear antibodies, anti-ENA: anti-extractable anti-nuclear antigens; DMARDs (Disease-Modifying Antirheumatic Drugs); IQR: inter-quartile range; LA: lupus anticoagulans; LDA: low dose acetylsalicylic acid; na: not applied; OAT oral anticoagulant therapy.

* anti-dsDNA titres were defined as low if <40 UI/mL, medium/high if >40 UI/mL

ᶜ anti-b2GPI was defined as >0.40 IgG Phospholipid Units (GPL); anti-CL as >40 GPL

°Low C3 was defined as <80 mg/dL; low C4 as <15 mg/dL

§ Moderate/high activity if SLEDAI-2K>6

^ Moderate activity/high if at least one organ/system scores A or B on BILAG-2004 index; organ/system involvement is defined as grade A, B or C for each domain

References

(1) S. Caielli *et al.*, A CD4(+) T cell population expanded in lupus blood provides B cell help through interleukin-10 and succinate. *Nat Med* **25**, 75-81 (2019).