
HOW DO I TRAIN
AGAIN AND AGAIN
By Kilian Jornet
SUUNTO

This is a guide of Kilian Jornet's workouts. These are training sessions of a professional mountain athlete with lots of years of experience. Carrying out these workouts and bringing the body to the limit requires a very good physical shape and experience. Each type of training must be adapted to the physical condition and the specific objectives of each person. We recommend consulting a professional before starting any training.

The Training Characteristics of Kilian Jornet

Training has been and it is my main occupation. I love to workout and to be pushing my body and discovering his limits, to be able to race or do projects in the mountains on my best possible level.

I started training "seriously" when I was 13 years old. Before that I had been doing activities and training mostly on the weekends (long days in the mountains) on holidays (some long hikes and summits) and during the week (cross-country ski 2-4 times / week in winter, running 2-4 times a week in summer). At 13 years old I entered to CTEMC (Centre Tecnificació Esquí de Muntanya de Catalunya) and started training on a regular basis, with a plan and a coach who gave me the trainings to follow. At 17 years old I started to do my own training plans and since then I have been training by myself. During the period from 2002 to 2017 I have competed in 413 races (265 in ski mountaineering - 107 Individual, 71 team races, 72 vertical rces, 10 sprint or relays) and 153 in trail running (81 Sky Races or up to marathon distance, 32 Ultra Trails and 40 Vertical Kilometers).

Here it is an extensive summary of the training characteristics since I started training until 2018 (30 years old). Day-to-day training diary data and physiological tests were analyzed. Training data was systemized by type of training (endurance, strength, and speed), intensity (low, moderate, and high-intensity), and mode (running, cycling, skiing, roll skiing, climbing and others). The scheduling phases, the specific sessions used, the training camps in altitude, the tapering for races and the day to day training. Following a 17-year linear increase in training load, the annual training volume during the last 7 years has stabilized from 1.000 to 1.200 hours, distributed across 400 ± 20 sessions. 90% of that is in endurance training, the 10% resting, strength and speed training.

My Training Principles:

These are the aspects and principles I'm looking for before starting any training planning or execute it. First of all, it is important to make a decision of the priorities of your life and where is the place of training in there:

a. Train for pleasure: Even if you want to win races, or train 7/7, you will invest on training but have other priorities in your life).

b. Live for training: it is long plan decision, that will take at least 10 years of your life, Training is the priority number one during this period, you do everything on your days around the training; eat for training, sleep for training, think for training, date for training, find a job or occupation to be able to live for training…

Depending on the decision trainings' organisation will be different. These following points are in a specific order. In my opinion is basic to have a knowledge and create a base before start thinking goals and doing really specific. Below you have more extensive developing of each point.

1. **Know yourself:** Have a knowledge of yourself. Your body (measures, morphology, biomechanics) your muscles, your cardiovascular system (VO2max, thresholds, recovery…) your technique and skills, your capacities, the climate where you perform, where you live, work…

2. **Note and analyse all the trainings**: more data you collect, more details you'll have and better can be the analysis after, and easier and more detailed you can identify directions (good and bad).

3. **Create a base:** create a solid base of volume and skills, the easiest and most effective is to practice since young kid and during years to create the best physiological base for the sport, the best muscular adaptation, morphology, nervous and cognitive systems.

4. **Work on "no physical" aspects**: when we think about training we use to think about hours doing physical workouts (endurance - speed - strength) and of course, this is the base to make the best tool (our body) but is important that this tool works perfectly. Technical training (circuit technical trainings, downhill, transitions…) as thinking on strategy, nutrition during races… Is as important as we can win seconds or minutes for "free".

5. **Feel your body:** have an understanding of how your body works, study anatomy, physiology and biomechanics, don't take any medicine or aliment supplements if you're not in a disease to feel exactly how and what your body is feeling, and find the best way (type of training, eating, strength exercise, psychological…) to identify the weakness or problems and work on that.

6. **Get used to pain**: Get your body and mind use to do hard workouts as it is used to sleep, eat… To feel great on a race you will have to have many painful (not feeling good, heavy or just painful) days. It is important to keep training in the pain (if it is not a problem - injury, then you need to identify - point 5). You need to put the body in a

lot of stress to have results after.

7. **Adjust the training to conditions:** Live and train on the conditions and situations you are going to find during the race or the activity until you feel 100% comfortable. More you train in different conditions, easier is to adapt to. (Altitude, humidity, social, night, food, terrain, psychological stress…).

8. **Explore your body in every limit in safety:** Far (in time) from competitions and in safety areas (close to home, where if you have a problem is not a life treat) get to your limits to know them and to push-it (strength, run down as fast as you can until falling, run as many days without food until you pass out, run without sleeping until you pass out…) So you really know the limits of your body and the feelings associated to the different moments.

9. **Try and fail until it works**. Try new exercises all the time to train, to progress. The 70% of the time the results will not be good, but continue trying and you will find the method or exercise that works well, until the body gets used to this intensity or method and you need to find new methods to put the body in more stress.

10. **Make goals**: Be honest with yourself, and make goals depending on your capacities (strengths and weaknesses) and how much you want to spend (years, hours a day, how much you want to push on trainings…). Make big goals (races, chronos…) and small goals to be checking that the training is going as planned (small races, X time to do a transition, downhills, legs strength…).

KNOWN YOURSELF

Know the environment and characteristics of sport/s

The training has been planed to perform in competitions in 2 competition sports; *Trail Running* and *Ski Mountaineering* and other activities as *Alpinism* and *Steep Skiing*. The first big step is to analyze the specifics and characteristics of the competitions or activities to train for. In SkiMo and Trail running, the efforts are ranging from short explosive races (Ski mountaineering sprint is 3 minutes and relay is 8 minutes +-) to prolonged endurance races lasting up to + 30 h (Ultra Trails or Alpinism activities). These competitions are performed across varying terrain (From dry warm climates as Western States 100 to technical terrain or cold in Himalayas, to easy trails…). Both trail running and ski mountaineering races the average aerobic energy contribution is 85–95%, but in some races to pass steeper parts or technical sections or the variation of terrain, it can be interval-based, with increased effort in steep uphill terrain and lower intensities in downhill or technical terrain. Accordingly, high aerobic capacity is of crucial importance in this sports, so the *V*O2max values. However it is also needed the ability to rapidly elevate the peak oxygen uptake, utilize a high fraction of the *V*O2max in all of the techniques, and have well-developed (skiing or running) efficiency and anaerobic capacity.

Know yourself

It is basic then to know yourself. First the morphotype and biomechanics of your body, then the physiological capacities. Also the technical skills and how you are in a psychological level. It is important to take all this data to make a table of strengths and weaknesses. The training plan should be elaborate individually from all this. It is great to get inspirations and ideas from the other's trainings but every person is different. Recheck these datas now and then to reevaluate and check if you're working on what you wanted. Every person has a different morphology, physiology response and adaptation to training (quality and quantity) and psychological qualities (accepting the pain, the failure or success…). So the training must be done individually considering all of those individual parameters. To arrive to a same result (winning X race) the perfect training plan and seances can be really different in athletes.

My physiological datas:

Weight: 55-58kg
Height: 172
Vo2 Max: 92*ml/min/kg* (74 at 13 years old, 83 at 18 years old)
Max Heart Rate: 200
Min Heart Rate: 34

The tests include also normally echocardiogram and ultrasound to have an overview of the health to practice sport. The physiological tests have been conducted at La Blume in Barcelona, primarily supervised by the Dr. Brotons. Also at Asepeyo in St. Cugat by Dr. Garrido, at CAR Sierra Nevada, at 2.500 altitude meters and at Hospital de Puigcerdà at 1.000m. The testing protocol used more often is the Bruce Protocol adapted for Ski Mountaineering. His higher values have been recorded at 92ml/kg/min at 391W and at 24% incline at 10.7 km/h. Anaerobic threshold (AT) was determined during treadmill running around 20% incline at 10 km/h between 175 and 180 HR (80% VO2max).

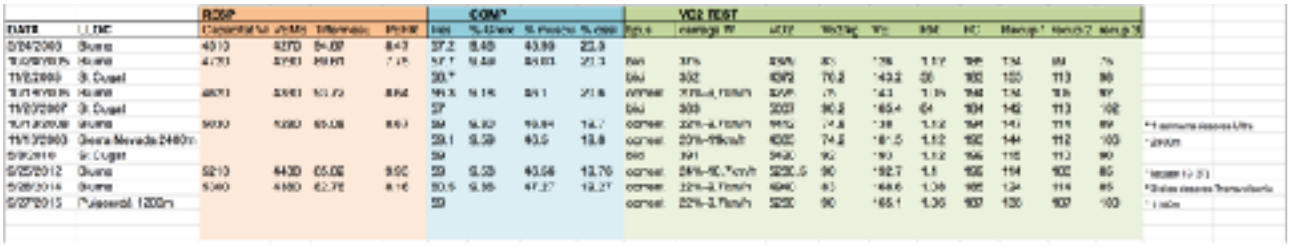
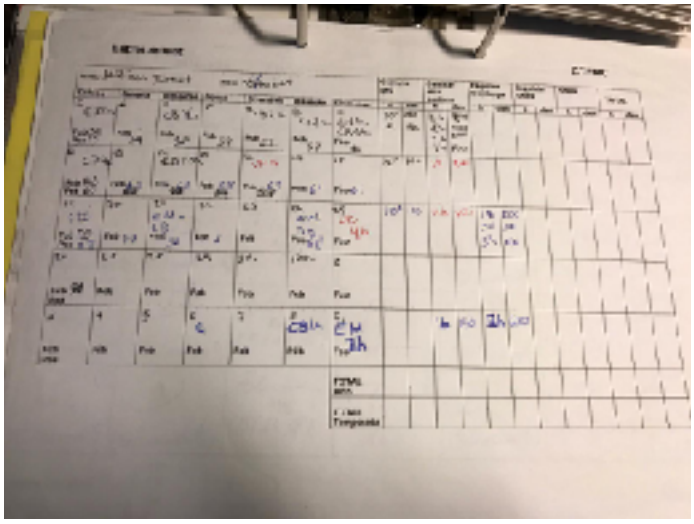
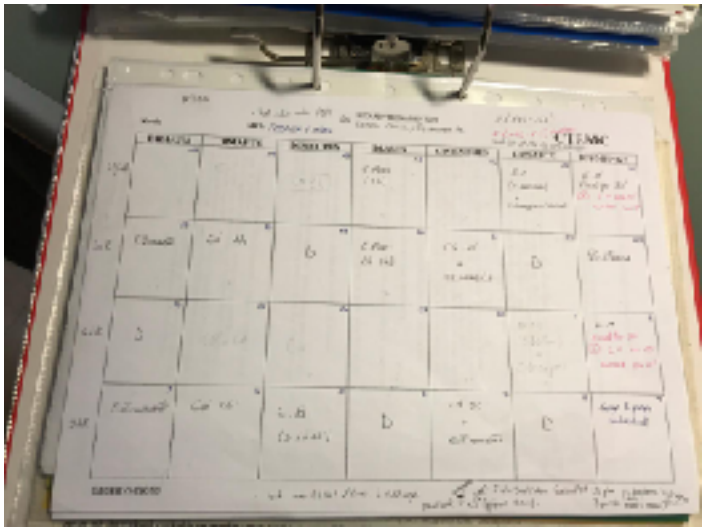


Table. *Physiological Tests*

NOTE AND ANALYZE

More data you collect of your trainings more accurate will be the analyze afterwards, easier to identify when is a problem or a success case of training. I have recorded all the training from when I started at 13 years old until today day by day. Note at least: sport, time, elevation, distance, feelings. If you add heart rate, speed or power (intensity), recovery (sleep quality, recovery after trainings) and some specific (SatO2 if you're in a training camp in altitude), lactate…It is also good to note the days you're sick or if you're traveling, if you take any medication or supplement…





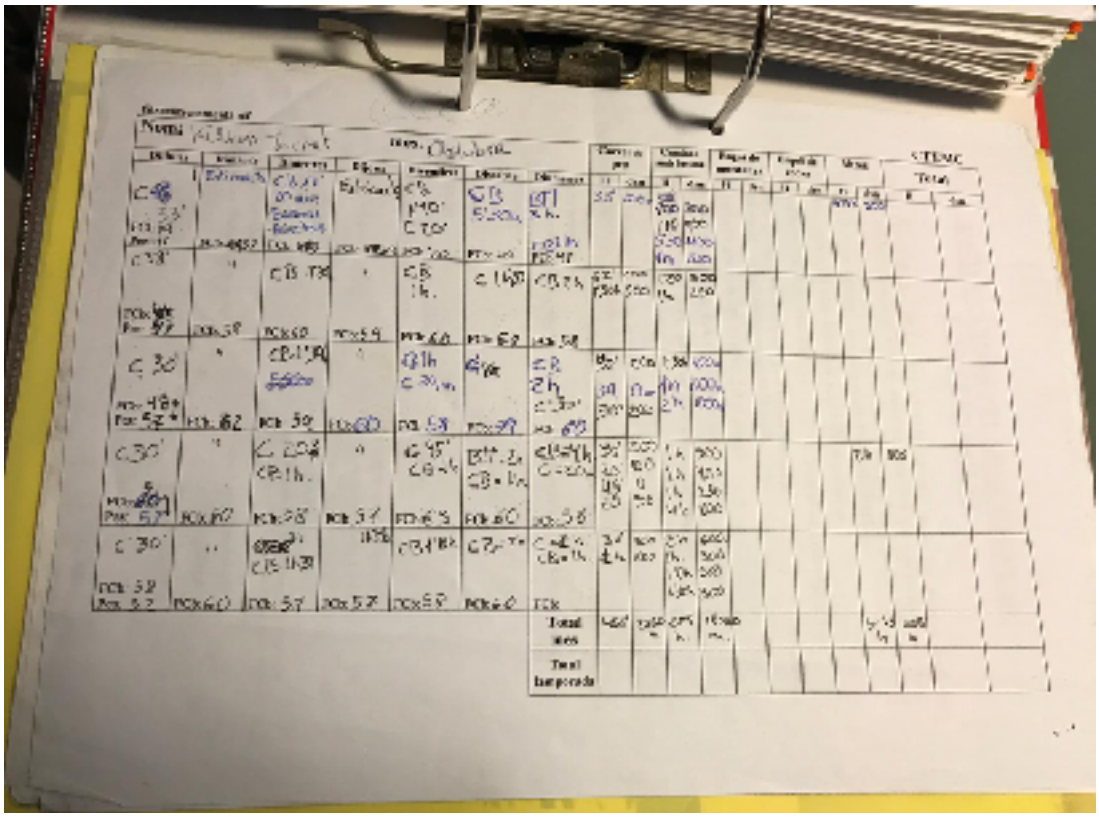


***Table**. Training diary when I was 13-15 years old.*

CREATE A BASE

You can't expect to perform from day 1 of training. To create a body adapted to the efforts in all ways (physiological, technical efficiency, neurological response, muscular adaptation) is needed a big base of training. This is built during years.

Childhood

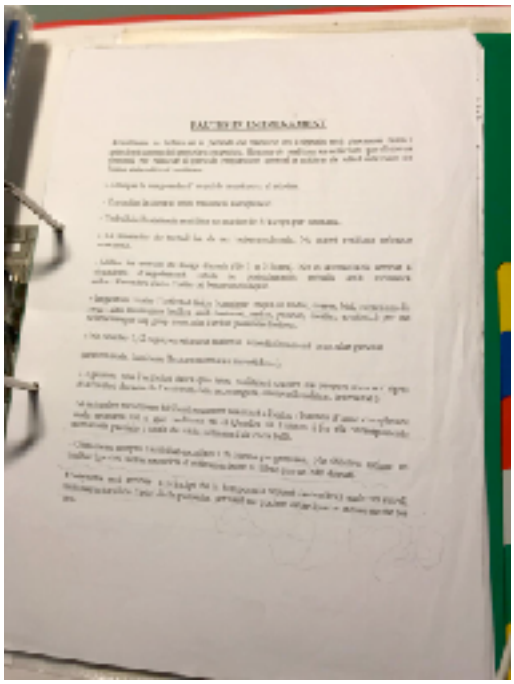
The first "long" hike I did by myself (my mother was walking in my side but not caring me) was when I was 1.5 years old, and it was 5 hours. When I was a kid, I was living with my

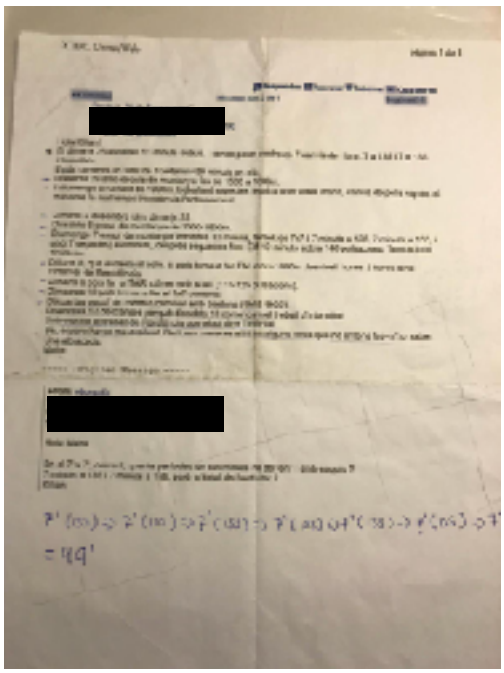
parents and sister in a mountain hut (Cap del Rec) in the Pyrenees at 2.000 m. On winter it is a cross country ski area so we were going to cross country ski and in summer and spring we were going to play in the forest around. I believe the muscular and articulation (ankles, knees…) adaptation as well as the neurotransmission and visual capacities are much easier to build on the early years, since our body is forming in a certain way depending the environment, needs and stimuli that gets. At 3 years old I did my first cross country ski race (12 km - Marxa Pirineu) and my first ascents at the summits in the area (1.000 m elevation gain). At 5 years old first 3.000 m summits and crampons / ice axes couloirs, at 6 some 4.000m summits, at 10 years old we did the Pyrenees crossing during 42 days, some long tours of several days cycling… During this period I was racing not seriously but doing some cross country ski races and cross (running) races. At 11 years old I started to get motivated to train and I did a big amount of training (for the age) in road cycling, and some races, as Transnacions, 150 km.

Teenager

At 13 years old I entered at CTEMC (Centre de Tecnificació d'esquí de muntanya de Catalunya) and I started training with some plan and strategy, as well as formed in technics, biomechanics of movement and safety in the activities. Jordi Canals was looking for us in terms of technique and Maite Hernandez was my physical coach. During the first 3-4 years of training the most important was not the results but to create a knowledge of how to train, to know my body and how it adapts to the stress, boost of trainings and to know how to be constant and methodic.

Table. *Conversations with my coach.*





Under Maite's trainings we focused the training on the volume (amount of hours in specific activity), discovering the intensity year by year and some strength and core training (2 times per week). During this period it was also a big focus in technical aspects: Downhill, circuit training (conversions, transitions, walk with crampons…). Filming gliding on flat and uphill, the movement of poles…

At 18 years old I started to train myself. I was studying Sports Science and I had the discipline and basic knowledges after some years under Maite's direction. During all this time I was increasing the training by +-10% per year.

From 18 to 24 years old my main training focus was big amount of volume at high intensity (N3-4) and to test new trainings and explore my possibilities. At 18 years old I started also to do trail running not only as a summer training but for racing and focus on racing in summer.

To race in ski mountaineering from December until the end of April and in trail running from early may to October it isn't really possible to do a classic scheduling (PPG - PPS - Competition - Rest - Transition). So the plan was in one Transition period - one month of General Preparation and a stable shape long period, without big shape peaks. To do that I usually organized my training years from November to October. I used to do 2 weeks easy or rest at the end of October. Then November was normally a month to spend in altitude (Stelvio or Tignes) and do a lot of meters elevation skiing at low and medium intensity. December was still high volume of training but introducing some serious interval training and first test races. From January to April it is the ski mountaineering racing season so it is mostly to keep training on the free weeks (I like to do big weeks even between races) and do the intensity mostly on the races (using the races as intensity training). It is not really a transition between the last ski mountaineering race (normally end of April) to the first trail running race (beginning - mid may). So normally I did 2 weeks of many kilometers and try to adapt and accept the pain of the legs after 6 month with no running. Then just keep big volume in weeks with no races and using races as intensity trainings.

Amount of Endurance Training:

YEAR	HOURS
2002	600
2003	600
2004	667
2005	700
2006	675 *
2007	812
2008	852
2009	881
2010	967
2011	1043
2012	1096
2013	1094
2014	1150
2015	1150
2016	1200
2017	1140**

% Of Sports in Training per Year

TOTAL	TEMPS	DNV	sessions
sport	**1201,55**	**642701**	**417**
SKIMO	536,55	370100	189
RUN	544	253601	164
CLIMB	56,5	0	46
BIKE	63,5	19000	17

Table. Volume of endurance training per year (no gym strength or technical workouts) *Surgery in Patella (3 month without training / ** shoulder surgery 1,5 month without training.

Endurance Training

I used to train the 88-90% on low intensity (Z1 to Z3) a 8-10% at high intensity (Z4 - Z5) and 2% at maximum intensity (Z6 - Z7). Normally during the pre-racing period (October - November) I started with making a big volume at Z2 and introducing slowly some Z3

intensity. In the previous months to first goals I put on a lot of volume at Z3 and some Z4 and Z5 short work closer to the races.

ZONE	METHOD	DESCRIPTION	MAXIMUM TIME	% VO2max	WORKOUTS EXAMPLES
I1	Recuperation	Recovery	> 6h	< 65	30-40' easy run
I2	Aerobic lipid	Endurance base	2h30-100h	65-75	5-10h run in mountains
I3	Aerobic Capacity	Rythme / tempo	1h-2h30	75-85	4x20' uphill / 2x1h / 2h tempo
I4	Aerobic Power	Racing pace	20 min to 1h	85-95	8x5' / 10x2' / 3x 10' / 3x 20' / 2x40'-1h
I5	Anaerobic Threshold	VMA, VO2 max	5-10 min	100	10x2'/ 8x4' / 4x6'/ 2'-3'-4'-5'-6'-5'-4'-3'-2'
I6	Anaerobic Capacity	Lactate capacity	30 s to 2 min	ns	30x30'' /15x40'' / 10x1'
I7	Anaerobic alactic	Short sprint	7-20 s	ns	5x10'' / 3x 20''

Some workouts modes I like to do are:

Z1: I don't like to work to many hours at Z1, only after races or the day before a race: short workouts, 30 or 40 minutes.
Z2: Is one of the zones where I spend the most part of the volume of training. I like to do long trainings, from 3 to 10 h at this intensity, to create a big volume. Trying to use the uphills to go at the higher part (or Z3) and use flats and downhills at the middle-lower part. These trainings are basics for me to create a big lipid adaptation, as normally I do these trainings without any energy intake. And to get the body to get more optimized at energy transfer to when doing long distances.
Z3: I do a lot of volume at Z3. I like to do a big amount of fast volume. In the racing period I almost only train at Z3 when is volume workouts (z1 to recovery and some z2 in longer than 4h trainings). I like to do some long repetitions, as 30 min to 1 h uphill repetitions starting at lower Z3 and finishing at higher Z3-Z4. With some 10-20 min (downhill) recovery and repeat 3-4 times at early season and some longer 1 to 3 hours still trainings at z3 during the season.
Z4: As in the z3 workouts, I like to finish uphills (last 5-10 min) at Z4, some specific workouts I do are 4 to 5 min repetitions at the beginning of the season to get adapted to the tempo and longer 10-30 min intervals (3 to 5 repetitions) later on the season.
Z5: I use to do some 30 sec - 30 sec workouts (or 40-20) at this zone during 15 to 20 repetitions. But only around 10 times per season. I use short races (Vertical Kilometers or Vertical Races) to do workouts at this intensity, or some last minutes of uphills in some fast trainings.

Strength and Speed Training

I was doing 2-3 times per week strength training from 13 to 18 years old (40% core stabilization and 60% strength training of arms and legs) During the last years (20–28 years old), I have not done any strength training but increasing the amount of Climbing training (is not specific strength training but a way to train both core and upper body strength. (60 h year). Also in Ski Mountaineering training during the downhill (a bit less in trail running) is a strength isometric exercise training.
Last year I have started with specific strength training. A typical strength session consisted of 20 min of core/stabilization exercises followed by 30 min of strength training (arms, upper body and quads).
Some specific exercises can be performed also in the outdoors, in both ski mountaineering as in some trail running (uphill races, races with steep ascents) it is very important to have a

great balance between Vo2max and anaerobic threshold and reactive strength of the legs (achilles tendon, calf, hamstrings, gluteus) to run/ski longer steps. I often do a 40 minutes - 1 h run uphill on steep terrain doing series of 2 or 5 minutes of (1) high frequency of short steps (160-190 steps per minute) then (2) low frequency of almost maximal length steps (50 to 75 steps per minute).

Exercise Modes and Organization of the Season:

I really divide my year in 2 parts: may to October only running as main sport (cycling - climbing too) and November to May Ski mountaineering. In a year, the 45-47% of the training (570 ± 50 h) is done running, 95% of this in technical terrain in the mountains, a 5% in flatter terrain in good trails or route. In elevation the running represents the 37-40% (250.000 ± 20.000 m). Same amount of training is in Ski Mountaineering, it represents the 45-47% of hours (550 ± 50 h) but it represents a bigger proportion of the elevation, the 55-60% (350.000 ± 50.000 h). When I was younger I used to do much more road cycling to combine in summer with running (50%-50%) but since I started taking running more seriously at 18 years old cycling has dropped to a 2-4% (15-70h). Sport Climbing represents a 4-5% of the training and other sports as roll skiing can represent between a 0 to a 4%.

If a season is filled with many different conditions / skills required, I think the blocs system works very well. That means organizing the season (or a biennial plan) in different blocks of 2 to 10 weeks with a main focus on. For example:

Bloc 1: 4 weeks sport climbing. (main goal is to improve the climbing skills and grade and strength).
Bloc 2: 8 weeks of endurance training (can be in ski, cycling or running or combining, but working mostly in endurance trainings z2 to z4).
Bloc 3: 3 weeks of speed training (working mostly in running skills in flat and speed at z4 and z5).
Bloc 4: 1 week of climbing remainder.
Bloc 5: 2 weeks of alpinism skills (endurance at low intensity in technical terrain).

So building the season to have intense periods to build some specific quality and organizing depending where the races or activities are and knowing how much and fast one quality get weaker. Then is important to do always a base to keep the other qualities some work to “keep in body memory” (3-4 short endurance runs during a climbing week, 2-3 times 1 h climbing session during endurance weeks…)

Altitude Training

I was living until 10 years old permanently at 2000 m, then from 17 to 23 between 2000 and 2500 m. The last 10 years I have been living in Chamonix Valley (1000-1400 m) and Norway (0 m) but spending many days in altitude. Total annual days spent at altitude has been 100 ± 30 (over 2000 m) from which 1250 h (52 days) over 4000 m (last 4 years with expeditions). Total training volume at altitude ranged from 300 to 465 h, accounting for 33-40% of the total annual training volume. The average weekly training volume is higher in altitude camps (~25 h) to (~35 h) but mostly at Z2-Z3.
The distribution in the year variates but normally is an altitude camp in November (~15 days), Some altitude days in December. Then just few days or none during the ski season.

Some days (~30-50) in early spring (April-May) in Alps or Himalayas. And Some weeks distributed during the summer (30-50 days from June to October).

Tapering toward Important races

The amount of volume remained stable across all prior weeks to races. Normally I do a stable training all the year, not looking for shape high points but to remain in a stable shape. The specific race preparation can be from 1 month to 2 weeks.

I would start to do a specific training 1 month before if it is a big difference between the race characteristics and my average training characteristics (look to next point - *Adjust Training to Conditions*). If it is a race developing in normal conditions (on mountain terrain - altitude between 0 to 4000 m) I would start preparation 2 weeks before the race with one week of specific training (train on similar conditions of the race (elevations, duration of the trainings, intensity, increasing the high intensity training, running flatter or steeper…) If it is just a week by week racing weekend I will just do a normal pre-race week.

The week of the race (if race is Sunday) I usually train normal until Wednesday (can be long volume, up to 5 h trainings, but trying to do not more than z3 intensity) During this days I can do some few repetitions of short intervals at z4 (4-5 repetitions of 5 minutes maximum) and some very short hight intensity (z5-6 10'' 4 -5 repetitions) depending the kind of race. Thursday or Friday (Race Day -3 / -2) I do a full rest day, that I use to travel if the race is in a driving distance. 2 days before the race I do a short 1-2h training at z2. The day before the race I do a 30'-40' z1-z2.

ADJUST YOUR TRAINING TO CONDITIONS

I believe it is really important to feel completely comfortable in the conditions of the race or activity to do. It is important in terms of movement adaptation (flatter terrain, steep terrain, more climbing, use of different muscles, if it is need to open tracks it will be much more need of legs slow strength, if it is flat in low altitude muscle speed may be important…) In terms of cardiovascular adaptation (longer, shorter, more or less intense…) but mostly in terms of visual cognitive connection, feeling psychologically confident on the situation and to adapt the body to the conditions (temperature, humidity, light, night, dangers as seracs, rocks fall, technicality of the terrain, stress of big championships with lot of public, loneliness in wide ranges…) Here some examples of specific preparations in this matter:

a. Sierre Zinal: Spending time (from one year to some weeks) at altitude around 2.000-2.500m, running flat fast trails, temperate climate and dry air, do big uphills with flat - fast trainings after…, try to lose weight in the upper body and try to be fast and light in the legs, work on psychology to be able to be in a bubble during the race (not get outside inputs). Do many races with high pressure of the result (world championships, important races…) to be used to the feeling and get more performance and excited than stress on these situations.

b. Matterhorn: I climb 10 times to the summit, knowing at every moment the route, the grip of the shoes on the different orientations, where the sun was

touching at every hour of the day…

c. Everest: to be comfortable alone in unexpected conditions, spend many days outside alone, for 10 to 50 h on technical terrain, on the limit of conditions (snowing, night, avalanche risk, during 30+ h…) doing on the outside comfortable zone in technical levels to finally feel comfortable and no stress when going to stressful situations. Build legs power opening track and do some pre-acclimatization: http://stories.kilianjornet.cat/pdf/Protocol_Acclimatisation_Everest_2017.pdf

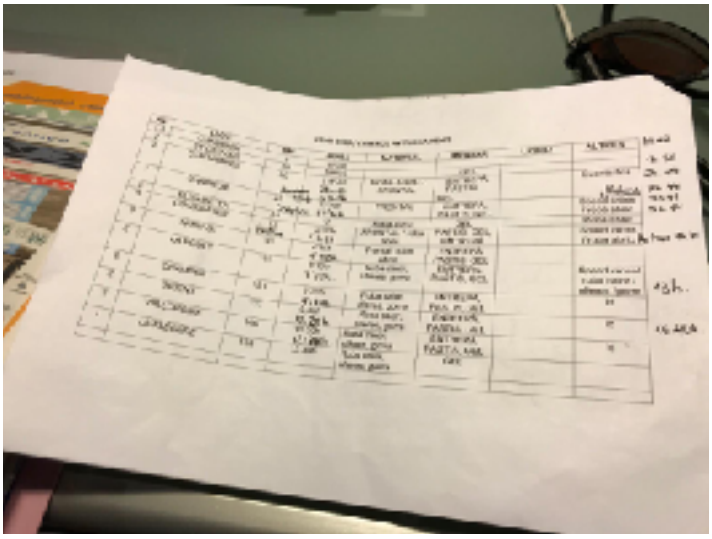
WORKING ON NON PHYSICAL ASPECTS

It is common to see athletes that have a big physical potential but never do good results or some that are much stronger training than on the day of the race of activity. It is very important on training the body to have the best physical capacities possibles of us but it is also very important to work on other aspects that finally make us to win or lose races, to be more efficient and safe. I would say it is 2 very important non-physical aspects to work:

a) ***Technical Training:*** It is the exercises to execute every movement and action the fastest and more efficient possible (lose the less energy possible for the maximum speed and precision). For that it is important to work biomechanics of our movement (filming how we run, ski or do any activity) and then identifying where we can improve and do specific exercises for that. Also it is a lot of repetition of technical movements (transitions, conversions, to put on and out skins, transition from uphill to downhill, but also make a belay, put protections, research with DVA, transition uphill downhill in running, technical terrain when it is rocks, slippery grass…) until they became automatic and then we will do-it in very different conditions (windy, with the eyes blind, answering maths questions, upside down…). Finally, an interesting exercise is to visualize those actions. When we are in the bed or in the transport, and before a race or during the race, we are arriving to this section to imagine each part of the movement, every detail. I train on technical aspects 1/3 1/4 of the hours I spend doing endurance training. Sometimes that can be combined (doing a circuit training: a 200 m uphill with different technical sections, so it is a technical work as well as a physical work), other times this training will be independent, doing-it at home some movements repetitions or after the physical training spending some time to do the exercises.
b) ***Strategy and preparation:*** The strategy during one race or activity will make us to success or to fail in many cases. It is many athletes that perform training and then when in a race

with the stress or on a big mountain with problems and some crucial decisions to take they underperform. For that, I would say the most important is to be really used to do the activity and in very different conditions to know how we react, what is happening and why. So, it is important to do many preparation races before a race goal or to do many climbing in different situations and increasing exposure and difficulties before one activity goal. Same for testing everything (equipment, sleeping, nutrition, hydration…) during many times before to put in real practice in a goal. And finally we need to make a plan, to know exactly what we want to do during the goal in terms of pace, strategy with or against other athletes, food, equipment, transitions… During the race or activity we need to adapt and have the resources and knowledges to adapt on the changes and problems that appears, but more than improvisation I would say it is a continued adaptation of the plan, so we never get out of resources or with a surprise.

***Table**. Food and pace strategy for my first UTMB in 2008*



EXPLORE YOUR BODY LIMITS ON SAFETY CONDITIONS

To know well your capacities and how your body works, it can be interesting to do some extreme workout experiments or tests. This should be done after a good base of training (5-6 years of good training) and before and far away from goals (at least some month, in case it is a big damage that can affect seriously the following month of training or racing). It is to try where are your limits in different training aspects and physiological capacities and do-it in a safe area (close to your home, somewhere where is people that can take you home or to hospital if you pass out, if trying technical skills of psychological skills do-it roped or somewhere if you fall you don't get injured, etc.). Here just a few examples of tests I have been doing:

- ***Energy metabolism:*** To know how much my body was able to keep working without any food I was training normally (2-3h morning - Font Romeu-Bouilloses area) and 1 easy run afternoon without any food (only water during the runs or home). 1st day I was hungry,

2nd day I lost the power but keep an ok endurance speed that remained until the 5th day when during the morning run I pass out. Before doing that I have always done many days running up to 8-10 hours without food. I now use to train always without food if it is not more than 7-8h workouts. During last year (2017) expedition in Everest I was doing 2 long pushes (+- 35 h) without many food (5 gels - 1 l of water) in high altitude and intense exercise. During the 2nd push the accumulation of lack of glucose made my brain to get some temporary dysfunction (my body was working well in lipids but the brain had not glucose) so after a short stop ATP was metabolized and work normal again.

- ***Drinking***: when I was 13-14 years old we did some long hikes and run tours without any water (10 to 15 h). Testing in cold and wet climates I have been able to run for 100 km (run in the Pyrenees) or up to 26h (in the Alps) without any water and feeling ok. In warm and dry climate (Western States, ~40°C) I had been not drinking much (3,5 liters) and after 100 km I had lots of full body cramps and a beginning of kidney failure.
- ***Altitude /Acclimatization***: Since my first experience in hight altitude in 2012 I have been testing different ways to acclimatize with some small improvements (Khumbu 2015, in 2 days from Kathmandu to 5000m-in 5 days to 6300 with good feelings), some big mistakes (Aconcagua 2014-to much hard training in hight altitude and no rest, then beginning of brain edema), until find a great protocol in 2017 (http://stories.kilianjornet.cat/pdf/Protocol_Acclimatisation_Everest_2017.pdf **).**
- ***Hight intensity in hight altitude***: In 2008 living at 2.500 m in Sierra Nevada I was going to top of Veleta 3392 m and doing maximum intensity for longtime (30''-30'' at z7 for 45') for some weeks with some overtraining problems and then figuring the good adjustment in the repetitions and recovery times to do high speed in high altitude. After I have been trying some kind of z7 intensity workouts on short sprints 20-30'' x 10 rep at very high altitude (5000-6000 m) with short recovery 30''- 1 min with bad results but better results on less repetitions (5-6) and longer recovery (2-5'). Same test with workouts at z3 at 6000 m. Doing 20h/week for 2 weeks made a period of 1 week really tired, but interesting for some kind of feelings and very hard workouts, and a 6-8 h/week made-it ok to feel good for many weeks.
- ***Climbing / skiing skills***: To find climbing skills to be comfortable in some soloing in the mountains, working many hours in rock and ice climbing in total safety (tope-rope and sport climbing). Same for skiing, to ski some turns very steep slopes (55-57-60-62°) in different snow qualities (ice, spring snow, powder…) in the borders of slopes or very short sections until the skis had no more grip or trying ways to do the turns, and falling many times without consequences to know exactly the grip on steepness and snow quality when I was going to the mountains.

CONCLUSION AND RACING

Training for endurance and mountain sports is a long process with up and downs that requires lot of time and dedication, study of the sport to understand the needs in terms of

physiology, biomechanics and psychology that requires and study of yourself to know how is your body and where it need to work and how it accepts and adapt to training charges. Then dedication and methodology to spend years of training following a plan with a lot of failure and worst results than expected to arrive at success. It is only with all these parameters that we can decide which are our goals and elaborate a concrete plan to reach-it. More we have been training and racing more we will understand our body and be able to perform. If conditions (external or internal) are not good, finding resources (strategies, race management, pushing more or less in some strength or weaknesses, taking away stress…) to have good results.

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