

**‘The Efficacy of a Novel Slow Feeding System on Intake Rate and
Behaviour of Normal and Hyper Reactive Stabled Horses’**

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Dedication

I would like to dedicate this thesis to Brian Fillery who sadly passed away last summer. He was the driving force behind this research. He was probably the only person who would have read this thesis from front to back with a smile! His dedication to research, equine nutrition and welfare was second to none. The experience I have gained working alongside him has helped to shape my career and for that I am truly grateful.

Declaration of Authors Rights

I declare that the work in this thesis was carried in accordance with the regulations of the University of Gloucestershire and is original, except where indicated by specific reference in the text. No part of this thesis has been submitted as part of any other academic award. The thesis has not been presented to any other Education Institution in the UK or overseas.

Any views expressed in the thesis are of those of the author and in no way represent the University.

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Abstract

The environment of the domestic horse is very different from that seen in the feral state. Confined housing conditions, high concentrate diets, limited forage, reduced locomotion and social isolation can result in the development of an array of health and behavioural conditions. Research to improve this environment and reduce the likelihood of such conditions is vital for the welfare of the stabled horse.

The aim of this study was to establish the efficacy of a novel slow feeding (SF) system on intake rate and behaviour of normal and hyper reactive stabled horses when compared to presenting hay in a hay net or loose on the floor.

Two in vivo studies were carried out to establish the effect each feed method (hay net, SF and loose hay) had on intake time (total intake time, mins/kg, g/min), bites and chews/min and on behaviour by looking at the following non-invasive biomarkers, behavioural initiation rate (BIR), Spontaneous eye blink rate (SBR), Heart rate (HR) and Heart rate Variability (HRV) during 30 minutes of feeding.

Presenting hay in a slow feeder significantly increased eating time when compared to a hay net or loose hay, with the slow feeder and standard grid slowing down intake rate from 24 minutes /kg to 39 minutes per kg, for loose hay and SF respectively, thus the SF increased intake time across both experiments by 1.6 times ($P<0.05$). Bite rate was affected by feed method with bite rate increases from 7.6 bites/min to 12.2 bites/min across all horses when comparing loose hay and the SF, the SF increased bite rate by 62% ($P<0.05$). Horses took a few days to acclimatise to the SF. Initial reluctance to feed from the SF was quickly overcome and initial increase in feeding time, decreased by 14.5mins as horses learnt to feed from it. Overall, horse behaviour in the stable (BIR, SBR, HR, HRV) improved, when hay was presented in an SF.

Using a slow feeder to increase feeding time had a positive effect on stable behaviour in hyper reactive horses and could help reduce the onset of stereotypic behaviours. Further research on a larger sample group and over an extended period is warranted to further establish the effect the slow feeder might have on behaviour, with particular focus on how it may help improve the welfare of stabled horse's long term.

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Abbreviations

<u>Abbreviation</u>	<u>Definition</u>
SF	Slow Feeder
HCL	Hydrochloric Acid
VFA	Volatile Fatty Acids
SI	Small Intestine
LI	Large Intestine
MRT	Mean Retention Time
EGUS	Equine Gastric Ulcer Syndrome
GIT	Gastrointestinal Tract
WSC	Water Soluble Carbohydrates
NSC	Non-Structural Carbohydrates
DM	Dry Matter
BW	Body Weight
RAO	Recurrent Airway Obstruction
BALF	Bronchoalveolar lavage fluid
HR	Heart Rate
HRV	Heart Rate Variability
ANS	Autonomic Nervous System
SN	Sinoatrial Node
HF	High Frequency
LF	Low Frequency
LF/HF	Low Frequency to High Frequency Ratio
SDRR	Standard Deviation of Beat to Beat Interval
RMSDD	Root Mean Square of Successive Differences
SBR	Spontaneous Eye Blink Rate
BIR	Behavioural Initiation Rate
LSD	Least Significant Difference
ANOVA	Analysis of Variance

FFT	Fast Fourier Transform
AR	Auto Regressive
SNS	Sympathetic Nervous System
Bpm	Beats per minute
SD	Standard Deviation
CNS	Central Nervous System
ESGU	Equine Squamous Gastric Ulcers

Chapter 1 Introduction

The feral horse spends approximately 60% of the time exhibiting foraging behaviour which accounts for 12-16 hours per day with voluntary non feeding periods such as drinking, resting and social interaction rarely lasting longer than 4 hours (Ellis, 2010). Feeding practices in the domestic environment are very different, high energy concentrate meals are fed two to three times a day with little forage available. This results in long periods of food deprivation and prevents the horse from exhibiting its natural intake behaviour (Sarrafchi and Blokhuis, 2013). This feeding scenario has negative health implications and can lead to obesity, colic, gastric ulceration, and laminitis (Wickens and Helenski, 2010). In addition, the onset of undesirable stereotypic behaviours, particularly weaving and crib-biting have been linked to reduction in foraging opportunity and stress inducing housing conditions (Wickens and Helenski, 2010).

Horse owners use hay nets of varying sizes to try to lengthen the feed intake time of the stabled horse by reducing the availability of forage. Although there is evidence to suggest that the use of small holed hay nets slightly reduces intake rate and therefore increases overall feeding time (Morgan *et al.*, 2015; Abrahamsson, 2012; Ellis *et al.*, 2015). Feeding hay in this way, compromises the horses natural feeding posture by forcing it to eat with its head in a raised position. Thus far no research has been carried out to assess the physiological effect of long term use of hay nets on the head, neck, back and teeth of stabled horses. Furthermore, there is a high prevalence of dental disorders in stabled horses that are subject to this feeding system (Dixon and Dacre, 2005). Research is required to investigate other possibilities to lengthen feed intake time without increasing calorie intake of the stabled horse.

An *in vivo* study was carried out by Hallam *et al.*, (2012) which studied the effect a novel feeding system had behavioural and physiological parameters when compared to traditional methods. The current study followed a similar methodology, testing a specifically designed slow forage feeder, with a particular focus on the effect feed treatment had on behaviour of normal and hyper reactive stabled horses by using a wider range of non- invasive biomarkers (SBR, BIR, HR, and HRV).

Aim of this study was to investigate the effect of a commercially available slow feeder on intake rate and behaviour in stabled horses. Firstly, it determined the effect the slow feeder had on intake rate, bites and chews per minute and behaviour in normal horses. Secondly it assessed the effect the slow feeder had on intake rate, bites and chews per minute on hyper reactive horses. Hyper-reactive horses have higher behavioural initiation rates and blink rates than normal horses thus to measure the effect the slow feeder had on this group could potentially reveal more information on the effects of trickle feeding on a divergent equine population and produce useful information on management of stabled horses.

The study addressed the null hypothesis:-

There will be no effect on feed intake and behaviour parameters when normal or hyperactive horses are fed hay in 3 different ways.

Chapter 2 Literature Review

2.1 Digestive Physiology

Horses are trickle feeding non-ruminant herbivores, evolved to survive on a varied low quality fibrous diet (Waran, 2007) on which they browse for up to 18 hours a day (Mills *et al.*, 2005). Such feeding patterns allow them to maintain a flow of feed through the gastro intestinal tract and thus provides a continuous supply of nutrients (Rafat *et al.*, 2009).

The main function of the digestive tract is to ingest and digest food, absorb nutrients and facilitate the removal of waste via defecation (Higgins, 2012). The digestive tract is split into two sections the foregut and the hindgut. The foregut consist of the mouth, pharynx, oesophagus, stomach and small intestine. The small intestine is broken down into three sections the duodenum, jejunum and the ileum. The hind gut is made up of the caecum, large colon and small colon. The large colon consists of the right and left ventral colons and dorsal colon, the small colon, rectum and anus (Weyenberg *et al.*, 2006).

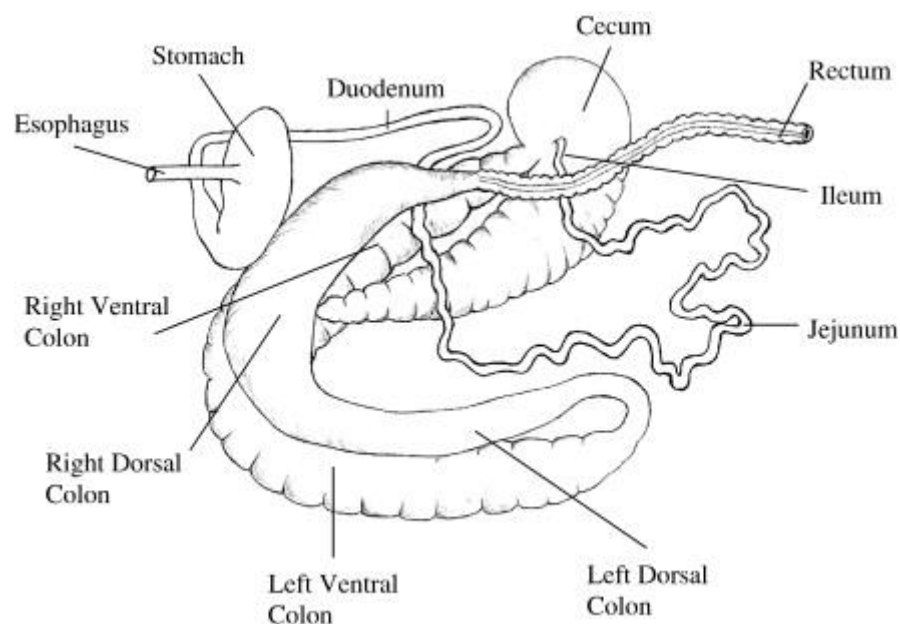


Figure 1. Digestive Tract of the Horse (Weyenberg *et al.*, 2006).

2.1.2 The Role of Saliva

The physical presence of food material in the mouth stimulates the secretion of large amounts of saliva, up to 10-12 litres per day (Rafat *et al.*, 2009). Chewing initiates the production of saliva from the mandibular, parotoid and sublingual glands which softens and moistens the food, the saliva does not have any digestive enzyme activity, but contains mucus which enables it to provide lubrication to prevent conditions such as choke (Frape, 2010). Saliva production is directly proportional to the number of chews, therefore a reduction in salivary production is seen in horses fed high concentrate diets (Rafat *et al.*, 2009). Reducing the overall forage content of the ration will reduce the number of chews and as a consequence reduce total time spent feeding. During forage feeding on average a horse will chew once per second, which equates to 3600 chews/hour (Meyer *et al.*, 1975) thus extended access to forage will increase saliva production and help buffer stomach acid.

The bicarbonate content of the saliva, is around 50 meq/l in the horse compared to 88-94 meq/l in bovine animals and 91-125 meq/l in ovine animals (Ellis and Hill, 2006; Frape, 2010). The bicarbonate content in the saliva acts as a buffer, mixing with the digesta material in the proximal region of the stomach and reducing the acidity in the a-glandular oesophageal region of the stomach. Those horses with reduced salivary production often due to high concentrate diets have lower gastric pH and are therefore more susceptible to mucosa damage and the potential development of ulcers (Rafat *et al.*, 2009).

2.1.3 The Equine Stomach

Horses are classed as monogastrics due to their simple single-chambered stomach, compared with a ruminant organism, like a cow, goat, or sheep, which has a four-chambered complex stomach (Ellis and Hill, 2006). The stomach of the horse is a small 'J' shaped organ and due to its shape is only ever 2/3 full with a capacity of 9-13 litres, making up 8-10% of the digestive tract (Frape, 2010).

In order to mimic the natural diet of the horse where they feed for 18 hours a day and to offset the effects of gastric acidity, horses are best suited to feeding little and often (Higgins, 2012). Unlike other species, where the production of hydrochloric acid is stimulated by feeding, horses produce a continuous flow, of up to 72 litres over a 24 hour period, even when the stomach is empty (Higgins, 2012). This feeding scenario leaves the stomach vulnerable to ulceration.

The function of the stomach is a temporary holding / preparation vessel where some limited break down of food begins via enzymatic activity e.g. breakdown of protein to polypeptide chains due to the action of pepsin. Most of the digesta will remain in the stomach for typically 30 minutes to 6 hours depending on composition of the diet.

When fresh digesta is offered the stomach initiates soft peristalsis contractions causing the old digesta to pass through to the duodenum. The stomach, however is rarely empty as soon as feed intake stops, the contractions decrease as does passage of feed to the duodenum (Weyenberg *et al.*, 2006).

The stomach has two distinct regions; the upper portion is non-glandular and contains squamous epithelial cells that lack a mucous layer, the lower portion is glandular and consists of secretory tissue, which produces acid, pepsinogen and mucus (Rafat *et al.*, 2009).

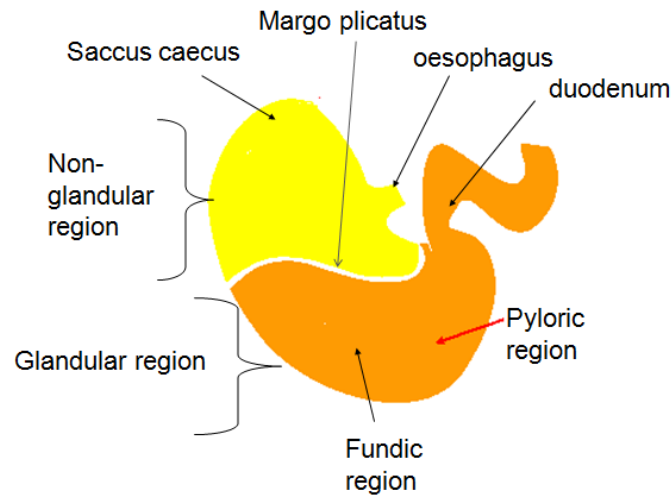


Figure 2. Sections of the Equine Stomach (Edited from Feeding the horse, 2012)

Saliva flow and the buffering action in the oesophageal region results in a variation of pH within each of the four stomach sections. The entrance of the stomach, oesophageal region (saccus caecus) has a high pH as a result of buffering of feed components, for example volatile fatty acids in ensiled feeds by saliva (Frape, 2010; Ellis and Hill, 2006). This region does not contain any digestive glands and acts as a storage vessel for food entering the stomach. When horses consume diets rich in non-structural carbohydrates, active fermentation occurs in the stomach, particularly within the less acidic oesophageal and fundic regions (Rafat *et al.*, 2009).

The second region is the cardiac region, containing cardiac glands, which secrete mucus, suggested to protect the stomach from gastric acid in exchange of chloride ions (Singer, 1998). The fundic region is slightly acidic with a pH of 5.4 and makes up the main body of the stomach. Gastric juices are secreted here in conjunction with hydrochloric acid (HCL) and pepsinogen (Ellis and Hill, 2006). HCL secretion is continuous but production reduces when the stomach is nearly empty and at this time the pH can be 1.5-2.0 (Frape, 2010).

The pyloric region is strongly acidic with a pH of 2.6, this environment stimulates, further HCL release which potentiates the activity of pepsin and protein digestion. The amount of protein digestion is limited in this region, due to the size of the stomach and the short length of time the digesta remains here (Frape, 2010). Moreover, the polypeptide hormone, gastrin is secreted into the blood by this region (Frape, 2010). Gastrin stimulates secretion of gastric acid and the daily production and release into the stomach can be up to 10-30 litres (Frape, 2010). Smyth *et al.*, (1989) reported that gastrin secretion, and potentially gastric acid secretion are directly influenced by composition of the diet and duration of feeding. In this study Smyth *et al.*, (1989) compared the effect of forage and concentrate feed rations on gastrin and insulin concentrations in the gut. Little change was reported in serum gastrin or insulin concentrations when feeding a forage only diet, however rations containing more readily available nutrients such as pelleted and sweet feed rations produced significant increases in both insulin and postprandial serum gastrin concentrations. The gastrin concentration varied according to the duration of feeding, this was not seen with insulin concentrations (Smyth *et al.*, 1989).

Feeding high starch or high fibre diets affects the microbial, chemical and digestive processes in different parts of the digestive tract of the horse. The impact of feeding high levels of starch on the production of D+ and L- lactate and various volatile fatty acids are in Table 1.

Table 1. VFA and Lactate concentrations in mixed digesta from the stomach of horses (De fombelle *et al.*, 2003)

	High Fibre Diet	High Starch Diet
pH	4.5	5.1
D-lactate	1.5	0.5
L-lactate	3.0	0.7
Acetate	9.7	15.7
Propionate	0.1	1.5
Butyrate	0.2	1.9
Valerate	0.0	0.4
D/L lactate ratio	4.2	2.2

Dietary fibre plays an important role in maintaining the physiochemical environment within the stomach. The viscosity of the digesta, the water holding capacity of the feed and potentially rate of emptying is affected by the ratio of soluble to insoluble fibre (Bach Knudsen, 2001). Therefore, entry of feed to the stomach and the distribution of particles within the stomach are vital for control of voluntary intake and the flow and utilisation of feed further down the gastrointestinal tract (Ellis and Hill, 2006).

2.1.4 The Small and Large Intestine

The small intestine is made up of three sections the duodenum, jejunum and ileum and is designed to carry out the break down and absorption of the simple carbohydrates, lipids, amino acids, vitamins and minerals in the diet (Ellis and Hill, 2006). It is 21-25 meters in length, makes up 30% of the digestive tract and has a capacity of 40-50 litres (Ellis and Hill, 2006). The pH of digesta entering the small intestine ranges from 2.5-3.5, the action of bile buffers the pH to increase it to 7-7.5. Duodenal glands release bicarbonate into the proximal jejunum and ileum as a result the pH rises to 7.8-8.2, these slightly alkali conditions within the small intestine are vital for active transport of nutrient substrates across the intestinal mucosa (Meyer *et al.*, 1993). Furthermore, it also provides the optimum environment for enzyme activity

(Ellis and Hill, 2006). Depending on composition of the diet food can be passed into the small intestine within 20 minutes (Davies, 2009).

The pancreas and liver aid digestion in the duodenum. The pancreas continuously secretes pancreatic juices and hormones into the blood stream. The most important hormones are glycogen and insulin which regulate blood sugar levels, the pancreatic juice also contains bicarbonate which helps to reduce gut acidity (Higgins, 2012).

Constant flow of bile from the liver directly into the duodenum emulsifies fat to allow for enzymatic digestion.

Digestive enzymes in the small intestine fall into three categories: proteases, amylases, and lipases.

Table 2. Digestive Enzymes (Pilliner, 1999)

Digestive Enzyme		Function
Protease	Pepsin Trypsin	Digest Protein
Amylase	Pancreatic Amylase Sucrose Lactase Maltase	Digest Carbohydrates (starch)
Lipase	Gastric, Pancreatic and Intestinal Lipase	Digest Fat

Non fibrous, soluble feeds will be substantially digested in the small intestine through the action of these digestive enzymes (Table 2). Digestion and absorption of carbohydrates, proteins, and fats is more efficient in the duodenum compared to the other two sections of the small intestine, the jejunum and ileum (Pilliner, 1999; Frape, 2010). Except for starch, most of the available nutrients are removed by the time digesta reaches the ileum and enters the caecum (Rafat *et al.*, 2009). Varlout *et al.*, (2004) suggested that digestibility of starch in the jejunum and ileum was around 88%,

far higher than those reported by Hintz *et al.*, (1971) and Potter *et al.*, (1992). The utilisation of starch is mainly due to degradation by pancreatic amylase and limited microbial degradation. However, horses are not well suited to diets with high concentrations of starch, despite many stabled horses receiving the majority of their diet in this form (Richards *et al.*, 2004). Starch digested in the small intestine is absorbed as glucose pre-caecally. Digestion of starch in the small intestine of the horse is not as sufficient as other species such as the pig because the horse produces only 8 to 10% as much amylase (Rafat *et al.*, 2009). Glucose released during digestion is transported across the small intestinal epithelium (Ellis and Hill, 2006).

If dietary starch exceeds the digestive capacity of the small intestine, variable proportions of ingested starch enter the large intestine. Varlout *et al.*, (2003) reported 4.6 times (37 vs. 8g/100kg BW) more starch entering the large intestine when horses were offered high starch diets compared with fibre. Inevitably this influx of starch reduces the pH of the large intestine. An acidic environment causes the rapid proliferation of lactic acid-producing bacteria, such as *Streptococcus bovis*, *S. equinus* and *Lactobacillus salivarius* resulting in increased lactic acid production and a further decline in the pH. Accumulation of lactic acid in the hindgut can cause lactic acidosis which is often accompanied by colic and laminitis (Rafat *et al.*, 2009).

The ileum has been suggested as the major site for protein digestion (Ellis and Hill, 2006). Proteins are broken down into amino acids, which are absorbed into the blood vessels through the gut wall, most of the protein digestion here comes from the concentrate feed with fibrous protein not easily digested in this region (Frape, 2010). A high proportion of the luminal microbial population in the jejunum and ileum is proteolytic in activity (Mackie and Wilkins, 1988). However, these processes are

affected by rate of passage through the small intestine. Rapid digesta flow reduces the time in which the digesta remains in the small intestine which can lead to some of the more complex sugars and starch escaping to the large intestine. Chemical and physical composition of the feed stuffs on passage rate has been found to be a major factor in nutrient absorption in the small intestine of the horse (Hill, 2007).

The digesta is not held in the SI for long, with some digesta passing into the caecum within 45 minutes of a meal. Merritt (1999) found that 50% of liquid markers instilled in the stomach of a pony reached the distal ileum within 1 hour and 25% were present in the caecum within 1.5 hours, with feed transit to the caecum more rapid post fasting. In consequence of the rapid transit of digesta through the SI, break down of the glucose bonds which make up starch, can be difficult.

The hind gut is made up of the caecum, large intestine and large colon which are responsible for the digestion of fibre and are the major site for microbial fermentation and absorption (Frape, 2010). The horses caecum is convoluted which slows down the rate at which the feed passes through and allows the microorganisms to work. Rate of passage in the caecum and colon is on average 35 hours, diets higher in concentrates accelerate passage rate through the small intestine (Ellis and Hill, 2006). However, consumption of long hay increases rate of passage through the hindgut, compared with pelleted diets with much smaller particle sizes (Weyenberg *et al.*, 2006). Further work by Moore-Colyer *et al.*, (2003) showed that mean retention times (MRT) in ponies fed two different lengths of hay and big bale silage ranged between 26 and 29 hours. Miraglia *et al.*, (2003) found MRT of mature heavy horses on a hay based diet was 21-40 hours decreasing within this range as intake increased. Large decreases in MRT however, were associated with a lower digestibility coefficient.

Horses cannot produce the enzymes that hydrolyse complex carbohydrates such as cellulose, hemicellulose and lignin found in plant cell walls, into their components parts suitable for absorption, therefore hydrolysis of these compounds is due to microbial activity (Frape, 2010). Fermentation in the hind gut of the horse is similar to that in the rumen; microorganisms ferment insoluble carbohydrates into energy producing substances known as short-chain volatile fatty acids (VFA), the main VFAs being acetic, propionic and butyric acids (Davies, 2009). The proportion and composition of these acids is influenced by diet. Willard *et al.*, (1997) and Muhonen (2013) found that horses fed concentrate diets had significantly lower percentages of caecal acetate and higher levels of propionate than those fed hay. Moreover, the hind gut physiological conditions also affect the proportion of VFAs (Rafat *et al.*, 2009). These VFAs are absorbed across the hindgut wall, transported by blood into different tissues, and used as an energy source (Rafat *et al.*, 2009). The contribution of VFA to the energy requirements of the horse can be as high as 70 to 80%.

The small colon is approximately 3.5m, spiral in nature and is one of the main sites of water and mineral absorption. The rectum is the termination point of the bowel from the pelvic inlet to the anus and is responsible for storage and expulsion of faeces (Ellis and Hill, 2006).

2.2 Feral Horse Time Budgets

In the feral state horses divide their time between drinking, food intake, roaming, rest and socialisation (Mills *et al.*, 2005). The amount of time spent on each activity, is referred to as a time budget, this is dependent on time of year, characteristics of the environment and the age, gender and temperament of the animal.

Studies have shown that free-ranging horses spend between 90-98% of their time feeding or resting, although there is substantial variation between the total times spent grazing (Duncan, 1980; Mills *et al.*, 2005). However, in the domestic environment horses may only spend up to 10% of their time feeding (McGreevy, 2004). In the feral state the variation in feeding rates has been linked to availability of forage. Horses grazing on sparse vegetation, such as deserts, have been seen to graze for 18 hours a day whereas those horses living in marsh land have been observed to graze for as little as 13 hours a day (Mills *et al.*, 2005).

The climate and weather conditions have also been seen to alter intake rates. A study which looked at a harem of horses living on Shackleford Island found that they grazed 61% of the time compared to 79% during the winter (Rubenstein, 1981). Furthermore, Keiper *et al.*, (1981) looked at Assateague Horses and similarly found that horses grazed for 65% of their time and rested for 32% during the summer compared to 81% grazing and 16% resting during the winter. Boyd *et al.*, (1988) studied 8 Przewalski horses at pasture concluding that they spent 5.9% of their time seeking food, during the summer, this activity was mostly carried out between 20.00 – 04.00 when the temperature was lower. It was concluded that horses spent the least amount of time seeking food between 08.00 and 12.00. These studies reveal a definite pattern of behaviour, with periods of intense grazing occurring early morning and early evening alternating with periods of rest. It is thought that during the night a decrease in insect activity and a reduction in temperature are the key factors associated with nocturnal resting time. All other behaviours such as grooming, drinking, resting, aggressive behaviour and reproductive behaviour occurring at lower frequencies rarely lasting more than 4 hours (Ellis, 2010 and Mills *et al.*, 2005).

2.2.1 Modern Feeding Practices

In the domestic environment there are a variety of methods used to feed forage to horses such as the hay rack, hay net and corner feeder. These are used in order to reduce intake rate and wastage caused by contamination with urine and faeces in the stable (McGreevy, 2004).

Research on 8 pairs of pregnant Shetland ponies has shown that when offered feed in a sloping trough (76.2cm long, 33-50.8cm deep sloping outwards) ponies will chose to move hay to the floor before eating it (Sweeting *et al.*, 1985). The ponies spent 5% of the total time pushing the hay, the activity which represented moving the hay out of the trough. The total eating time was 47% when ponies ate from the ground when compared to 57% from the trough (Sweeting *et al.*, 1985). These results indicate that ponies prefer to eat from the ground, which reflects the normal grazing posture of the horse in which the visual field is wide. Visual contact between co-specifics was limited throughout this research, which did affect intake rates, showing that social facilitation is important in maintaining feeding behaviour in ponies.

2.2.2 Common Feeding Methods

Hay nets of varying sizes are used to try to lengthen the feed intake time of the stabled horse by reducing the availability of the forage. Research has revealed that small holed hay nets increased eating time in horses by 40-67% compared to forage fed from the ground. (Morgan *et al.*, 2015; Glunk *et al.*, 2014).

In addition, feeding method and dry matter of forage has been found to have a significant impact on intake rate (Abrahamsson, 2012). When fed from the ground horses consumed 1.29kg per hour, 0.72kg from a small mesh hay net and 0.3kg from a

wired rack. Feeding rate from the wire rack was increased when forage was wetter to 0.75kg per hour, suggesting that the dry matter of the forage is also of importance (Abrahamsson, 2012). It was concluded that feeding consumption was lower when eating from the small mesh hay net compared to feeding from the ground.

Hay net size influenced intake parameters, chewing time increased by 5min/kg which equates to 20% compared to large nets (Ellis *et al.*, 2015). Use of multi-layer hay nets and multiple feed stations has also increased eating time (Ellis *et al.*, 2015).

Interestingly, night observations showed no difference in the overall forage intake time between hay nets, even though short term intake rates would have been expected to decrease in horses using the small meshed hay nets.

Although there is evidence here to suggest that the use of small holed hay nets slightly reduces intake rate and overall feeding time (Morgan *et al.*, (2015); Abrahamsson, (2012); Ellis *et al.*, (2015); Glunk *et al.*, (2014), the extension in foraging time is limited and therefore research is required to investigate other possibilities to lengthen feed intake time without increasing calorie intake of the stabled horse.

2.2.3 Consequences of using Hay nets

Hay nets force the horse to eat with their head in a raised position compromising their natural posture. Whilst eating from hay nets horses have been seen to exert a high level of force when pulling forage from the nets, causing hay nets to lift off the wall and upwards, which is applying a lot of pressure on the head joint, neck, back and teeth (Ellis *et al.*, 2015). Horses have also been seen to display frustration behaviours, caused by restricted access to forage which is displayed through head pushing of the nets (Ellis *et al.*, 2015). Thus far no research has been carried out to assess the physiological effect of long term use of hay nets on the neck, back and teeth of stabled

horses. Moreover, it has been cited that stabled horses have a greater prevalence of dental disorders, in the form of uneven incisor wear potentially due to mastication only in one direction as well as presenting less pronounced molar movement resulting in an increased formation of dental hooks (Dixon and Dacre, 2005). These dental disorders could be a possible effect of continuous use of hay nets, however this requires further research.

There is also evidence to suggest that this unnatural feeding posture coupled with the stable environment has a deleterious effect on the efficacy of the mucociliary escalator in clearing the upper air-ways of inhaled particles. Fungal spores, inhaled from dried feed stuffs, can result in inflammation of both the upper and lower airways and induce allergic respiratory disorders (Holcombe, 2001). Hay nets also pose the risk of horses becoming snared, by trapping their hoof (McGreevy, 2004).

A proposed solution to reduce intake rates and restrict availability of forage without compromising the health status of the horse is to use a slow feeder. Hallam *et al.*, (2012) studied the effect of a novel all-inclusive feed bin system, known as a slow feeder, on intake rate compared to traditional feeding practices. The study aimed to remove stressful feeding times by providing an *ad-lib* diet. The slow feeding system had a positive effect on stress parameters and stable behaviour, no frustration behaviours were observed and foraging in bedding and heart rate reduced during this trial. There was also a significant increase in feed intake time ($P < 0.01$). When hay was fed using traditional feeding methods intake time was 22 mins/kg, however the average feed time from the slow feeder was between 50-65 mins/kg (Hallam *et al.*, 2012). Despite this evidence for the effectiveness of a slow feeder system, there is anecdotal evidence to suggest that commercially available slow feeders are not fit for

purpose. Many owners are complaining that the products are breaking and that the metal grills used to restrict access to forage are damaging incisor teeth (Smartpak, 2015). Furthermore, the long term effect of the slow feeder has not been studied with regard to practicality and equine acceptance.

2.3 Health and Behavioural consequences associated with Modern Feeding Practices

Common feeding practices consisting of a high concentrate diet fed in small rations accompanied by little forage provides a radically different nutritional profile from the diet horses would be able to choose or select in the feral state (Waran, 2007). These modern feeding practices have benefits but also potential disadvantages to the horse both nutritionally and behaviourally which may impact the welfare status of the animal.

2.3.1 Gastric Ulceration

In order to meet their nutritional requirements feral horses spend a large proportion of their time, often up to 20 hours a day grazing on poor quality forage (Sarrafchi and Blokhuis, 2013). Feeding practices in the domestic environment are very different to that of the feral horse, high energy concentrate meals are fed two to three times a day with little forage available. This results in long periods of food deprivation and prevents the horse from exhibiting its natural grazing behaviour (Sarrafchi and Blokhuis, 2013). This feeding practice is used so that the increased energy requirements of the performance horse can be sufficiently met. Food deprivation can lead to gastric ulceration and irritation.

The cause of gastric ulcers in horses is multifactorial, however there are a number of key factors that have been suggested to effect the severity and prevalence of them. Strenuous exercise has been found to have a directly adverse effect on gastric

physiology (Furr *et al.*, 1994; Murray *et al.*, 1989). However, diet and eating behaviour have been found to be the most important contributing factors (Lybbert *et al.*, 2001; Smyth *et al.*, 2011).

The squamous portion of the stomach is the most common site of ulceration as it is more exposed to acid damage, due to the fact that it lacks the bicarbonate/mucus layer of the glandular region (Orsini, 2000).

The physical presence of forage in the mouth stimulates salivary production. Saliva production is directly proportional to the number of chews, therefore an increase in salivary production is seen in horses fed high forage diets (Rafat *et al.*, 2009). The bicarbonate content of the saliva causes it to act as a buffer, mixing with the digesta material in the proximal region of the stomach and reducing the acidic environment and potential development of ulcers (Rafat *et al.*, 2009). Gastrin is a peptide hormone secreted into the blood which stimulates secretion of hydrochloric acid (Smyth *et al.*, 2011). Studies have shown that serum gastrin and potentially gastric acid secretion are directly linked to diet and duration of feeding a specific diet (Smyth *et al.*, 2011). The highest incidence rate is found in stabled horses fed high quantities of concentrate feed, these horses have also been found to have lowered stomach pH and higher blood gastrin levels (Murry *et al.*, 1996; Smyth *et al.*, 2011; Orsini, 2000).

Furthermore, exercise appears to have an effect on the stomach that is independent of feeding as horses fed the same diet before and during training had higher gastrin levels whilst training. It is unknown whether this is a stress response or a physiological effect, this warrants further investigation. However, it does suggest that exercise itself may be a predisposing factor in the development of gastric ulcers. Studies have shown that 52% of 100 yearlings, 66% of 195 racehorses and mature horses had ulcers in the

squamous portion of the stomach (Hammond *et al.*, 1986; Murray *et al.*, 1989). Lesions appeared to be chronically progressive during training and to regress during retirement (Hammond *et al.*, 1986; Orsini and Pipers, 1997; Murray *et al.*, 1989).

Stress is another factor which is potentially linked to gastric ulcers, more specifically to epigastric distress or severe stress causing ulcers in foals, but only in the glandular region of the stomach (Furr *et al.*, 1992). Therefore stress could be a contributing factor to the prevalence of ulcers in those horses that are intensively housed and exercised thus exposed to stress in their environment. This also requires further research. However, stress seems less likely to be a significant causal factor because ulcers in mature horses are more frequently seen in the squamous region of the stomach (Furr *et al.*, 1992).

Furthermore, horses that suffer from gastric mucosal injury have been seen to exhibit behavioural signs of colic. This may suggest that horses are able to detect the damage to the mucosal lining or the pain which it is causing (Wickens and Helenski, 2010).

2.3.2 Colic

Colic has been defined as an onset of visceral abdominal pain (Mehdi and Mohammad, 2006). The pain is caused by a thick sticky mass of fermenting feed or a compacted mass of forage in the stomach or intestines (Frape, 2010). Pain associated with colic increases and decreases in conjunction with intestinal smooth muscle contractions (Frape, 2010). It has been found to be a significant cause of morbidity and mortality in horses and large intestinal conditions are amongst the most common causes of the condition (Tinker *et al.*, 1997; Reeves *et al.*, 1989; Williams *et al.*, 2011).

The horse has a highly specialised large intestine, evolved to deal with ingestion of large amounts of fibre. Domestication and stabling have considerably altered the natural diet of the horse, as a result of high level concentrate feeding the horse is susceptible to increased gastrointestinal problems (Hudson *et al.*, 2001).

There are a variety of management factors which may contribute to the risk of colic, with dietary factors playing a major role. Studies have shown that stabled horses have an increased risk of colic over those kept at pasture (Hudson *et al.*, 2001). Horses that are stabled are usually fed concentrate meals with reduced access to forage. When ingesting a large concentrate feed the rate of passage of digesta through the foregut, due to chewing, ingestion rate and particle size is increased when compared to forage (Ellis *et al.*, 2002).

Type of diet and volume of feed affect the rate of passage and type of digestion that occurs with lower feed intakes associated with higher mean retention times (Pearson and Merritt, 1991; Drogoul *et al.*, 2001).

Furthermore, exercise has been found to affect gastrointestinal function, by reducing the dry matter digestibility of feed and mean retention time in horses (Pagan *et al.*, 1998). Lower intestinal motility seen in stabled horses may be explained by both a reduction in exercise and reduced access to forage compared to pasture kept horses with continual access to both movement and forage (Hudson *et al.*, 2001). Lower motility levels have also been recorded in the mornings which could be linked to low levels of activity overnight, with higher intestinal contractions seen in the afternoon, however this requires further study.

In humans abdominal cramping and diarrhoea are reported more commonly in runners and constipation is more frequent in those that are inactive, these observations also

suggest that exercise may stimulate gut and colonic motor activity, but there is limited evidence to support this theory. Research in healthy humans by Cammack *et al.*, (1982) showed exercise significantly accelerated gastric emptying but this was contradicted by Coenen *et al.*, (1992) whose data has shown exercise had no effect on bowel transit time. Clearly more work is required on the effect of exercise on GIT transit times in all species.

Research has shown that there are a number of additional dietary risk factors associated with colic such as ; recent change in hay, type of grain or concentrate feed, feeding >2.7kg of oats per day and hay fed from round bales (Hudson *et al.*, 2001). Poor quality hay is often less digestible which can cause alterations to colonic pH, VFA production and colonic microflora, conceivably predisposing a horse to disorders of intestinal dysfunction resulting in colic (Cohen *et al.*, 1999). Work by Kaya *et al.*, (2009) reported that decreased water consumption can also precipitated colic.

Moreover, research has shown a potential genetic predisposition to colic in Thoroughbred populations with the lowest breed significance in Arab populations (Hudson *et al.*, 2001; Tinker *et al.*, 1997). The highest incidence rate has also been found in horses between 2 and 10 years old, showing age as a potential risk factor (Tinker *et al.*, 1997). Age can be an indicator of the horses' level of activity and feeding regime, which is related to the apparition of colic.

It has also been cited that previous episodes of colic, crib-biting, windsucking and horses that have travelled within the previous 24 hour period may also be more susceptible (Hillyer *et al.*, 2002).

The risk factors associated with the onset of colic (such as exercise, feed regime and composition of diet, travel and stereotypy) in horses are vast and complex, further studies are required to establish how these factors alter gastrointestinal function.

2.3.3 Obesity

Obesity is defined as the accumulation of excessive adipose tissue and is the most common nutritional disorder in companion animals. Equine obesity is an increasing but under-recognised welfare issue in the UK (Robin *et al.*, 2014).

In humans obesity is associated with poor health and chronic medical conditions such as diabetes, hypertension, respiratory, cardiovascular disease and arthritis. Similar associations can be made between obesity and health status in equids (Mokdad *et al.*, 2003; Wannamethee *et al.*, 2004).

Despite the importance of weight management and the welfare concerns surrounding obesity there are limited publications on its prevalence or potential risk factors.

Previous studies have reported risk factors including gender, height, age group (reduced risk <5 years), breed, exercise, access to pasture, access to hay and amount of concentrate fed to be related to obesity (Thatcher *et al.*, 2012; Robin *et al.*, 2014).

Exercise is essential for reducing body mass and maximising insulin sensitivity in both horses and humans (Dube *et al.*, 2012; Stuart-Hunt *et al.*, 2006; Powell *et al.*, 2002).

Highest incidence of obesity is seen in companion animals, competition animals are likely to be managed in a different regime with more intense exercise periods which will contribute to the reduced risk of obesity in this subpopulation (Robin *et al.*, 2014).

Trieber *et al.*, (2006) found that ponies with a history of laminitis had significantly higher BCS and reduced insulin sensitivity than ponies without laminitis, predisposing them to obesity. Further work has also shown equine obesity to impair

thermoregulation, athletic performance, alter oestrous cycles and increase inflammatory cytokine production characteristics (Robin *et al.*, 2014).

There is also a seasonal link to obesity, with obesity highest in summer compared to winter (Giles *et al.*, 2014). This has been disproven by Dugdale *et al.*, (2011) and Trieber *et al.*, (2006) who found no significance of obesity between seasons. This suggests that seasonal variations in appetite and body weight may be suppressed in obese animals which may explain the lack of seasonal variation in risk of obesity seen in these studies. Furthermore, it has been shown that after 2-3 weeks continuous access to a single feed, ponies will stabilize their body weights, consuming 2-3% of their bodyweight in dry matter in a 24 hour period (McGreevy, 2004). Despite this finding in support of *ad-libitum* feeding, due to the high starch diet of domesticated horses, it is required that horse owners control intake. To do otherwise is known to cause metabolic disorders such as laminitis or temperamental volatility (McGreevy, 2004). However, reducing calorie intake in horses can lead to digestive upsets and promote the onset of stereotypical behaviour, due to long bouts of food deprivation (Moore-Colyer *et al.*, 2015).

2.3.4 Laminitis

The Causes

The NRC (2007) considers that there are three theories of aetiology associated with laminitis.

- 1) Vascular haemodynamic (blood flow)
- 2) Toxic, metabolic or enzymatic
- 3) Traumatic or mechanical overload

2.3.5 Feed Related Laminitis

Equine Laminitis is the second largest cause of death in horses after colic (Frape, 2010).

The most common cause of laminitis is feeding or exposure to excess quantities of soluble carbohydrates, voluntary or infused (Bergsten, 2003). Grass makes up a major part of the equine diet. Feral horses graze where vegetation is sparse and forage quality is poor. However, in the domestic environment, pastures have been improved via plant breeding and fertilization, in order to maximize microbial protein synthesis in the rumen of cattle and sheep and to increase milk yield. The high content of non-structural carbohydrates (NSC) and crude protein in treated pasture can have deleterious effects on grazing horses (Bergsten, 2003; Rafat *et al.*, 2009).

Photosynthesis causes green plants to produce simple sugars. When these are produced in excess of the energy requirement of the plant for growth, they are converted into storage carbohydrates (Longland and Byrd, 2006). The vegetative tissues of temperate pasture grasses store fructans and sucrose as their reserve for energy (Longland and Byrd, 2006). Simple sugars and fructans comprise the water soluble carbohydrate fraction of the plant. The non-structural carbohydrates (NSC) consist of simple sugars, fructans, and the starch fraction of the plant (Longland and Byrd, 2006).

Fructan content in pasture is highest in spring, lower in summer and intermediate in autumn. Photosynthesis during the daytime and carbohydrate usage by the plant leads to a maximum water soluble carbohydrate intake occurring during the afternoon (Longland and Byrd, 2006). Studies have shown that WSC in pasture grasses, can double during daylight hours with increases from 160-240WSC/Kg DM occurring within 3 hours (Longland and Byrd, 2006). NSC content can accumulate to >400 g/kg of dry matter (DM) in pasture grasses (Longland and Byrd, 2006). With daily intake of

fructans during grazing ranging from 2.5-10.5% g/kg body weight (BW) (Longland and Byrd, 2006). The upper end of this range has been seen to fall within the range of oral fructant induced laminitis (Milinovich *et al.*, 2007). Emphasising the risk of laminitis in grazing horses and the importance of monitoring intake.

Fructans have been found to be capable of inducing laminitis in clinical studies (Milinovich *et al.*, 2007; Watts, 2004). High levels of fructans as well as simple sugars are found in grass that is subjected to stress caused by changing climatic conditions. Hay which is made from stressed grass, may contain up to 35% (DM) NSC (Watts, 2004). The amount of NSC is affected by a number of factors: species of forage, light intensity, temperature, nutrient and water status and growth stage (Watts, 2004). Horses that are overweight or insulin resistant and therefore predisposed to laminitis should consume diets based on grass hay, specifically mature hay that contains visible seed heads and a high stem to leaf ratio, because it has a lower digestible energy and NSC content in comparison to less mature hay (Geor and Harris, 2009). Alfalfa hay is less desirable as it contains higher energy and NSC content in comparison to grass hay. An NSC content of less than 10% is recommended for horses at risk of laminitis (Geor and Harris, 2009).

Rapid fermentation of these carbohydrates in the hind gut (caecum and colon) can result in intestinal disturbances, which causes a chain of events that results in laminitis. There is further evidence to suggest that intake of concentrate feeds rich in these carbohydrates can exasperate hyperinsulinemia in animals which are predisposed (Geor, 2009). Recommendations for cereal grain intake should be no more than 0.2-0.25% BW per meal (Frape, 2010, Huissein *et al.*, 2004) However, this scenario still

resulted in a fall in caecal pH from 7.04-6.74 showing the sensitivity of the gut in response to starch intake (Huissein *et al.*, 2004).

Based on experimental and epidemiological studies it is evident that composition of diets and feeding management are of great importance when trying to minimise the risk of laminitis, especially weight management and intake of NSC and WSC (Longland and Byrd, 2006; Milinovich *et al.*, 2007; Watts, 2004).

2.3.6 Behavioural Disorders

The development of equine stereotypic behaviours has been associated with reduced welfare and a suboptimal environment (Wickens and Helenski, 2010). Both experimental and epidemiological studies have been carried out on a range of species to establish the underlying causes and the function of stereotypic behaviour. These studies have shown a link between feeding regime and housing conditions which restrict social interaction and locomotion as being crucial for the development of stereotypic behaviours (Wickens and Helenski, 2010). Research has also suggested that the performance of stereotypies is caused by stress; the behaviour has been hypothesised to reduce stress in the captive environment, acting as a coping mechanism (Sarrafchi and Blokhuis, 2013). In addition, to this neurological studies have suggested that the performance of such behaviours may provide the animal with pleasure which increases the motivation to perform them (Sarrafchi and Blokhuis, 2013). Stereotypic animals that have become addicted to the reward of dopamine release, achieved during crib-biting and are not influenced by access to forage or environmental enrichment (Moore-Colyer *et al.*, 2015). It is proposed that increased transmission of dopamine may promote coping in the suboptimal environment.

Performance of these behaviours is very time and energy expensive for the horse and often interferes with other vital behaviours such as resting and eating, which can lead to a reduced ability to maintain body weight (Waran, 2007). By understanding the causes horse owners can amend the domestic environment to reduce the risk of such behaviours occurring as well as reducing performance in horses that have established the behaviour, so that welfare reducing prevention methods crib collars, anti-weave bars are not required.

The use of environmental enrichment has been a successful technique for improving the domestic environment of horses (McAfee *et al.*, 2002; Wurbel *et al.*, 1998; Henderson and Waran, 2001). The use of mirrors in the stable has been seen to be more effective in reducing weaving behaviour than physical prevention via anti-weave bars (McAfee *et al.*, 2002). It is proposed that the mirrors mimic visual contact, reducing the social isolation of the stable environment. In addition to this it is thought to provide environmental distraction which alters the horses' perception of the environment (McAfee *et al.*, 2002).

Further studies have also shown that stereotypies were reduced on large yards where horses had visual contact with a large number of other horses (Waran, 2007).

Moreover, the use of a grill between stables to allow horses to have both visual and tactile contact was seen to reduce weaving and nodding behaviour compared with those kept in loose boxes (Waran, 2007). Emphasising the need for social interaction between co-specifics.

Similar results have been seen in other species. A study by Wurbel *et al.*, (1998) looked at wire gnawing male laboratory mice of the ICR strain, 16 mice were used in the study. Half of the mice were kept in barren cages and the other half were provided

with an environmental enrichment in the form of a cardboard tube. Enrichment reduced wire gnawing by 40% and mice spent more time resting and grooming. The tube was thought to provide them with a sense of security in the form of shelter and increase their wellbeing (Wurbel *et al.*, 1998).

Increased foraging and eating time has also been seen to reduce performance of stereotypic behaviours. When horses are provided with *ad-lib* access to hay, they have been observed to spend half as much time in free choice movement than horses that are given restricted forage (Stanley *et al.*, 2015). It is not always appropriate to provide *ad-lib* hay due to concerns of obesity, an alternative would be to provide an environmental enrichment tool that allows foraging behaviour to occur when the horse chooses. The 'Equiball' is an example of this and has been proven to reduce the frequency of crib-biting in stabled horses (Henderson and Waran 2001). It has been suggested however that frustration behaviours when the ball is empty may occur (Hothersall and Nicol, 2009).

Feeding of high energy concentrate feeds with low fibre content and restricted access to forage has been associated with a higher incidence of stereotypic activity (McGreevy *et al.*, 1995 and Gillham *et al.*, 1994). Furthermore the initiation of bouts of stereotypic behaviour has been linked to feeding regime. Cooper *et al.*, (2000) found that weaving occurred most commonly prior to receiving a concentrate feed which may be linked to the stress and anticipation associated with specific meal times. Conflicting results by Whisher *et al.*, (2011) found that significantly more crib-biting occurred throughout the night when compared to day time observations. One train of thought suggests that this was because of the lack of forage available over night.

Further evidence of this by McGreevy *et al.*, (1995) showed that the risk of behavioural disorders in Thoroughbreds increased when horses received less than 6.5kg of forage per day when bedding materials other than straw were provided and when the box design prevented social interaction between co-specifics (McGreevy *et al.*, 1995). This suggests that the availability of forage has a direct impact on behavioural output.

Furthermore, another factor which has been seen to reduce stereotypic behaviours is increased time at pasture and social contact. Oral stereotypic performing heifers were not observed performing such behaviours when out at pasture (Redbo, 1990).

However, they spent 25% of their time performing stereotypic behaviours after the grazing season when they were tied in stalls and 11% of the total time spent performing the behaviour before the grazing season (Redbo, 1990). Heifers are kept in similar conditions to the domestic horse where they are in restricted housing. A feeding system which can mimic natural feeding behaviours would be an avenue for further research, as time at pasture may not always be practical for horse owners where grazing is limited.

2.3.7 Respiratory Disorders

Disease of the respiratory tract is the second most common performance limiting condition affecting horses, after problems associated with the gastrointestinal tract (Ramey, 2004). The clinical signs associated with respiratory disease are coughing, nasal discharge, respiratory pattern and rate and exercise intolerance (Mair *et al.*, 1998). Age is a factor associated with type of respiratory disease, with young horses more prone to contagious infectious diseases such as strangles and *Rhodococcus equi* infection. Whereas mature horses, over 4 years, are more susceptible to allergic diseases such as RAO/COPD (Mair *et al.*, 1998).

2.3.8 Equine Asthma - Recurrent Airway Obstruction / Chronic Obstruction Pulmonary Disorder

Recurrent airway obstruction (RAO, heaves, COPD), is a performance limiting disease affecting 14% of horses in the UK (Hotchkiss *et al.*, 2007). RAO is characterised by measurable airway obstruction that is induced by exposure to airborne antigens present in organic dust and is the most common problem affecting stabled horses (Robinson, 2006).

The predominant cause of these antigens is via stabling and the provision of hay and straw. Exposure causes inflammation of the small airways, mucus accumulation, bronchial hyper reactivity and bronchospasm (Robinson, 2006). The pro inflammatory agents present in stable dust are bacterial endotoxins, mould, microbial toxins, forage mites and pollen. Furthermore, high levels of potentially toxic gases such as ammonia may also be present in poorly ventilated stables (Pirie, 2014).

Further research, is required to ascertain the importance of each organic dust component in the aetiopathogenesis of RAO (Pirie, 2014). Exposure to these antigens results in a disease phenotype with varying severity ranging from exercise intolerance to coughing and expiratory dyspnoea (Mair *et al.*, 1998). The disease is mostly reversible, avoidance of the inciting air borne antigens results in significant reduction in symptoms. However, competition schedules, weather conditions, health and nutritional demands often mean that horses cannot be removed from the aeroallergen-rich stabled environment. Moreover, the most common treatment is the administration of bronchodilators and corticosteroid drugs, which can be expensive and long term can prevent horses competing due to violation of competition rules. The latter has also been

linked to the onset of laminitis (Ramey, 2004). Therefore, reducing stable aeroallergen levels via the treatment of fodder is a more desirable solution. Moore-Colyer *et al.*, (2015) reported that steaming hay reduced bacteria by (99%), mould by (99%) and respirable particle count by (94%), which provides evidence of a potential hay preparation method to reduce fodder allergenicity and thus symptoms of RAO.

Increased risk of RAO has been linked to age (≥ 4 years) breed predisposition in Thoroughbred populations and season, winter and spring posing the highest threat (Couetil *et al.*, 2003). With Hotchkiss *et al.*, (2007) identifying respiratory infection and exposure to hay and straw early in life to be a significant risk factor for RAO. Breed association supports the findings of other studies that suggest a strong genetic, as well as environmental, basis for RAO susceptibility (Ramseyer *et al.*, 2007; Marti *et al.*, 1991). Furthermore feeding method and the associated breathing zone increases likelihood of airway inflammation and RAO in stabled horses. Studies have shown that horses fed from hay nets have higher bronchoalveolar lavage fluid (BALF) neutrophilia, increased exposures to respirable particles, inhaled particles and respirable endotoxins compared to those fed from the ground (Ivester *et al.*, (2014); Holcombe, 2001).

2.4 Measuring Cognitive Function through Non- Invasive Biomarkers

Assessment of a stress response has been found to be most accurately carried out using a combination of both behavioural and physiological measures (Young *et al.*, 2012). Physiological data collection, includes heart rate (HR) and salivary cortisol. Both of which are established indicators of stress and cognitive function in response to behaviour of horses. Both methods of data collection are non-invasive, thus avoiding any further stress to the animal. Behavioural data collection can be carried out by looking at

spontaneous eye blink rate and behavioural initiation rate which can then be used in support of the physiological data.

2.4.1 Heart Rate and Heart Rate Variability

Heart rate and heart rate variability (HRV) are used to assess activity of the autonomic nervous system in response to acute or chronic stress (Schmidt *et al.*, 2010). Cardiac function is regulated by the autonomic nervous system (ANS). The sinoatrial node (SN) acts as the primary pulse generator for heart beats. The SN is under control of both the parasympathetic (vagal) and sympathetic nervous system. Generally activity within the vagal nerves decreases heart rate and activity within the right sympathetic nerve increases heart rate. A horse at rest has a heart rate of between 35-42bpm (Higgins, 2012). Rapid changes in heart rate are always caused by shifts in vagal regulation (Von Borell *et al.*, 2007). An increase in heart rate during feeding or other husbandry tasks can be indicative of stress (Higgins, 2012).

Heart rate variability is classed as short term fluctuations in heart rate, and is based on the antagonistic oscillatory influences of the sympathetic and parasympathetic nervous system on the nodus sinoatrial of the heart. It reflects the usual balance of sympathetic and parasympathetic vagal tone (Schmidt *et al.*, 2010). It is a particularly good indicator for non-invasive assessment of ANS activity in response to psychophysiological stress (Von Borell *et al.*, 2007). Psychological stress may impact sympathovagal balance in the absence of any physical changes in heart or respiration rate (Von Borell *et al.*, 2007).

Human studies which look at pre surgery stress have failed to demonstrate a relationship between anxiety levels and mean heart rate but have found a reduction in the relative intensity of the high frequency (HF) - component of HRV (representing a

reduction in vagal activity) which was positively correlated with pre-surgery anxiety levels (Sleigh and Henderson, 1995). Although this research was only conducted in human subjects, it is thought that the same principles can be applied to non-human mammals (Von Borell *et al.*, 2007).

A study comparing control horse HRV with stereotypic individuals indicated that the latter may be more stress sensitive because of their lower basal parasympathetic (HF component) and higher sympathetic (LF component) activity, even when heart rates did not differ between groups (Bachmann *et al.*, 2003). Indicating that the sympatho-vagal balance (LF/HF component) may be a useful tool for assessing stress and stereotypy susceptibility in horses.

Schmidt *et al.*, (2010) established use of HR and salivary cortisol together as sensitive parameters to detect stress in 'routine' transport of horses. Concluding that, generally, a reduction in the values of the HRV variable standard deviation of beat to beat interval (SDRR) and root mean square of successive RR differences (RMSSD) reflects a change towards more sympathetic dominance, whereas increased values is indicative of a shift towards more parasympathetic dominance (Schmidt *et al.*, 2010). A reduction in RMSSD can be due to external stressors. Whilst at rest horses have a high parasympathetic tone, however, sympathetic tone plays little role in determining heart rate (Schmidt *et al.*, 2010).

Reitmann *et al.*, (2004) found correlations between HRV, heart rate, behavioural parameters and stress in 20 warmblood horses during a challenging ground-exercise task. HRV has also been used to quantify specific aspects of a horse's temperament and this parameter may prove to be a useful indicator of temperament and of coping strategies in horses (Visser *et al.*, 2002; Von Borell *et al.*, 2007).

Studies have reported gender related differences in ANS regulation of cardiac activity, with mares showing a higher vagal tone, which is consistent with research done in humans. Basal values of HRV in horses also appear to show large inter-individual variance, the exact origin of this is unknown but thought to be due to factors including genotype, behaviour and nutritional status (Von Borell *et al.*, 2007). These factors must be considered when conducting research on multi-sex groups and when comparing individuals. Furthermore, the application of the monitor and environment may influence the validity of the results, due to stress caused by the application of the monitor. This is reduced in horses that are subject to a 10 minute acclimatisation period (Young *et al.*, 2012).

2.4.2 Spontaneous Eye Blink Rate

Spontaneous eye blink rate (SBR) is found to be a non-invasive but functional, reliable and useful way to monitor central dopaminergic activity and function in the striatum (Karson 1983, Kaminer *et al.*, 2011). Dopamine is associated with a range of functions such as reward, motivation and learning. It plays an important role in goal-directed behaviour and in maintaining a behaviour once a task is learned (Colzato *et al.*, 2009).

SBR has been used to determine striatal functioning particularly in stereotypy subjects. A reduction in SBR has been associated with increased postsynaptic receptor sensitivity, with subjects exhibiting stereotypy displaying lower mean SBR (Roebel and Maclean, 2007). Patients suffering from Parkinsons, have dopamine depletion and therefore demonstrate reduced SBR, this particular condition is attributed to lower dopamine availability rather than postsynaptic receptor sensitivity. On the other hand, patients with schizophrenia exhibit significantly increased SBR due to elevated dopamine availability (Karson, 1983 and Kaminer *et al.*, 2011).

In addition, eye blink rate can be used as a measure of muscular tension, increased blink rate has been linked to increased muscular tension caused by task induced stress in humans and has been a useful tool in discriminating between conditions of tension and relaxation (Drinkwater, 1968).

Various studies that look at stress-induced stereotypies including cribbing in horses, postulate that stress stimulates endorphins, triggering the release of striatal dopamine (Rendon *et al.*, 2001). Striatal dopamine has been linked with SBR and it is therefore of value to assess rate of SBR in control and hyperactive horses in order to determine the effects of different feed treatments.

2.4.3 Behavioural Initiation Rate

Behavioural initiation rate is the number of behavioural transitions performed in a given period (Roberts *et al.*, 2015). Garner and Mason (2002) studied bar-mouthing bank voles, observing significantly higher numbers of behavioural initiation, suggesting disinhibition of the striatonigral pathway of the dorsal striatum of these animals. The dominance seen in the striatopallidal pathway results in a significant increase in the number of behavioural switches carried out (Garner and Mason, 2002)

Stereotypy animals, such as crib biting horses show alterations in dopamine physiology and have been observed to have a higher BIR than control horses (Roberts *et al.*, 2015). This can be linked to research that has shown dopamine antagonists to increase the number of behavioural switches in a range of species (Garner and Mason, 2002; Garner *et al.*, 2003). Similarly to SBR, Striatal activity and dopamine levels have been linked to BIR in animals, therefore making BIR worth assessing in control and hyper reactive horses to establish effect of the environment.

Furthermore, the type of behaviour exhibited can be used to assess stress level and flight response. Particular behaviours are linked to high stress and coupled with physiological stress parameters such as HRV, BIR and SBR give a reliable estimation of stress status in the animal (Young *et al.*, 2012). The following behaviours, have been defined as high stress in horses: agitated, fidgety, anxious, active, aggressive, uncomfortable, weaving, box walking repetitive head movements, stamping or kicking with hind feet and snorting (Young *et al.*, 2012).

2.5 Scope of this study

Aim of this study was to investigate the effect of a commercially available slow feeder on intake rate and behaviour in stabled horses. Firstly it determined the effect the slow feeder had on intake rate, bites and chews per minute and behaviour in normal horses. Secondly it assessed the effect the slow feeder had on intake rate, bites and chews per minute on hyper reactive horses. Hyper-reactive horses have higher behavioural initiation rates and blink rates than normal horses thus to measure the effect the slow feeder had on this group could potentially reveal more information on the effects of trickle feeding on a divergent equine population and produce useful information on management of stabled horses.

There will be no effect on feed intake and behaviour parameters when normal or hyperactive horses are fed hay in 3 different ways.

Chapter 3 Experimental Work

3.1 Experiment 1 Methodology

3.1.0 Study Population

In order to carry out this research 2 geldings and 1 stallion were used. The mean height of the horses at the withers in cm was 165.3 (Range 164-167) which is displayed in Table 2. The mean age of the horses in the group was 10 years old (Range 5-16).

Variability in gender, age and temperament is important to ensure that the data can be representative of the equine population as a whole.

Table 3. Study Population Experiment 1

Horse Number	Age	Height (cm)	Weight (kg)	Gender	Discipline
1 - Abdullah	16	165.10	598	Gelding	Showjumper
2- Chance	9	167.74	574	Stallion	Covering Stallion
3- Balou	5	164	538	Gelding	Showjumper

3.1.1 Experimental Design

The experiment was carried out as a 3x3 Latin square design thus treatment, period and horses differences will be accounted for.

Experiment one was carried out on 3 normal horses, each horse was subject to three feed treatments, loose hay from the ground, from a hay net and from the Haygain slow feeder (novel all-inclusive feed bin system). Each horse was fed each feed treatment for 3 weeks. Total study period was 9 weeks.

Table 4. 3x3 Latin Square used for Experiment 1

Feed Method	Hay net	Loose Hay	Slow Feeder
Period			
1	H1	H2	H3
2	H3	H1	H2
3	H2	H3	H1

(H1= Horse 1 H2= Horse 2, H3=Horse 3)

3.1.2 Management Regime

All horses were stabled with exercise periods restricted to dry-lot turnout, ridden exercise, use of the horse walker and lunging. Stables were fully matted (8X10ft), with automatic drinkers, horses were bedded on shavings and fed hay post steaming hay in a HG2000, and feed amounts were based on 2.3 % bodyweight.

Morning concentrate feeds were given at 8am, hay rations were fed at 9am and all data was collected before noon. Evening concentrate feeds were fed at 5pm and hay was given at 5.30pm.

3.1.3 Data Collection

In order to account for acclimatisation period measurements were taken at the beginning, middle and end of each feed treatment period in order to account for any adaptation to the feed treatments.

For phase one of the trial numerical data was recorded for feed intake behaviour (intake time, bite rate, chews /minute) on Day 1, 11 and 20 of each 3 week period. Behavioural output data (heart rate, heart rate variability, behavioural initiation rate per 30 minutes , spontaneous eye blink rates per 30 minutes) was recorded on Day, 2, 10, and 21.

3.1.4 Condition Score and Weight Estimation

The Condition scoring system used (Leighton, 1981) assessed the amount of subcutaneous fat over the hindquarters by applying a scale of points from 0 to 5, zero indicates very poor and 5 grossly obese. Half scores are used in between to give an 11 point scale. In order to get an accurate condition score, visual assessment must be accompanied by manual inspection (Leighton, 1984).

Three areas were inspected:

- 1) Pelvis and top of the quarters
- 2) Back bone and ribs
- 3) Base of the neck

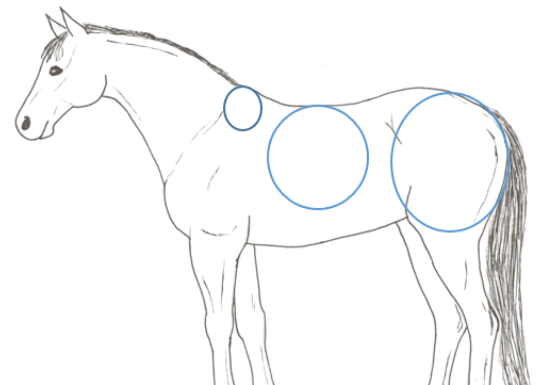


Figure 3 Areas Assessed in Condition Scoring

The pelvis score was adjusted by half a point if it differed from the back and neck scores to give the condition score.

In order to assess live weight of each animal a Spillers Weigh tape was used (Spillers, 2016).

3.1.5 Intake time, Bites and Chews per Minute

On day 1, 11, 20 of Phase 1 each horse was fed 2kg of steamed hay and intake time was measured using a stop watch (Karrimore Run Stopwatch, Sports Direct). Horses were left to acclimatise to the feed treatment for 5 minutes prior to data collection. At the beginning, middle and end of feeding, bite rate per 30 minutes and number of chews per minute were recorded using a hand held tally counter (Jazooli, Amazon UK). To ensure data was collected accurately, bite and chew rate was recorded in 4 x 15 second periods to total 1 minute.

3.1.6 Heart Rate and Heart Rate Variability

Heart rate was measured using a Polar V800 Heart Rate Monitor (Polar Equine, 2016). The HR monitor consisted of an electrode belt that picked up the electrical activity of the horse's heart. A transmitter attached to the belt enabled wireless communication of the HR to a wrist watch receiver. The belt was fitted around the horse's thorax and secured with a surcingle. Both electrodes were placed to the left-hand side of the horse. One electrode was placed approximately 10 cm below the withers, and the other 10 cm behind the elbow over the heart (see Fig 4).

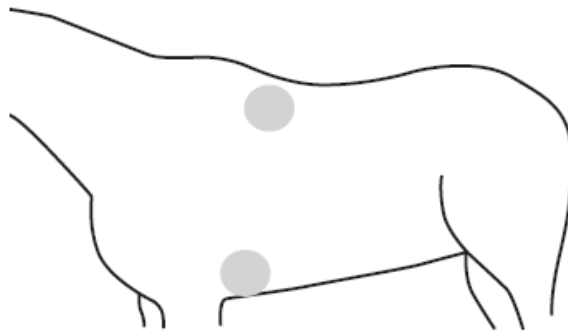


Figure 4. Electrode Placement (Polar Equine, 2016)

Warm water and KY lubricant jelly were used to optimise contact between the horse's skin and the electrodes. The wrist watch receiver was attached to the surcingle to ensure it remained within signal range. All horses were given 10 mins to habituate to the equipment according to the methods of Ellis *et al.*, (2015) and Youngs *et al.*, (2012).

Heart rate was measured for 30 minutes during morning feeding on day 2, 10 and 21 of each 3 week period. Baseline heart rate was recorded 3 days prior to the start of the trial to ascertain a mean HR. Each horse wore a head collar and lead rope and stood in

the wash box loosely tied during baseline data collection, heart rate was measured over a 30 minute period.

3.1.7 Spontaneous Eye Blink Rate

All horses were given their morning hay and SBR was recorded during a 30 minute period using a hand tally counter. Spontaneous eye blink rate (SBR) as defined by Karson (1983) is the bilateral paroxysmal brief repetitive eye closures occurring continuously. Considering the anatomy of the horse, true bilateral eye closures would be difficult to measure therefore only the left eye was observed for all horses.

Horses were observed in their box, on day 2, 10 and 21, three repetitions were taken to ascertain mean SBR. Baseline SBR was recorded in a 30 minute periods on the 3 days prior to the trial start day, during these observations horses wore a head collar and lead rope and were loosely tied in the wash box.

3.1.8 Behavioural Initiation Rate (BIR)

Behavioural initiation rate was recorded in a 30 minute period, from 18.30-19.00 approximately one hour after evening feeding to establish BIR during each feed treatment without the presence or interference of humans. This observation was repeated three times (Day 2, 10, 21) to establish a mean behavioural initiation rate for each horse during each feed treatment.

All behaviours were defined and documented using an existing ethogram, however only number of behavioural transitions were recorded. Notes were made with regard to type of behaviour observed to assist analysis. Each bout of behaviour was recorded as a new initiation regardless of the previous behaviour, for example the sequence

'Feeding- Drinking- Standing at Rest –Feeding- Grooming' would be recorded as 4 behavioural initiations.

The behaviour of the subjects was recorded 24 hours a day using a Swaan DVL8-4150 CCTV unit (Maplin Electronics, 2016) secured at ceiling height in the corner of each stable in an appropriate position to gain an adequate field of view. The CCTV cameras were linked to a smart phone application in order to monitor feeding behaviour at all times and assist in the measurement of BIR.

3.1.9 Data Analysis Experiment 1

Data analysis was carried out in two stages. Firstly, in order to take account of adaptation to feeding method data collected on day 1,2 at the beginning, day 10,11 in the middle and day 20,21 at the end of each 3 week phase was subjected to a repeated measures analysis of variance (Genstat 15). Secondly, in order to establish the effect each feeding treatment (hay net, slow feeder, loose hay) had on intake and behavioural parameters a one way analysis of variance was carried out, with horse and treatment as factors.

Repeated Measures Analysis of Variance

All raw intake data (intake time, chews per minute, bites per minute) and behavioural initiation rate and spontaneous eye blink rate were tabulated into spreadsheets using Microsoft Excel (2010), where descriptive statistics were applied (mean, standard deviation) for all horses (n=3). Three treatments, three horses and three periods were used as factors thus n=9, differences between means were determined using post-hoc least significant difference (LSD), $LSD = t [\text{error df}] \times \text{s.e.d.}$, used to determine differences between means.

One Way Analysis of Variance

All raw intake data (intake time, chews per minute, bites per minute) and behavioural initiation rate and spontaneous eye blink rate were tabulated into spreadsheets using Microsoft Excel (2010), where descriptive statistics were applied (mean, standard deviation) for all horses (n=3). A one way analysis of variance was carried out using Genstat 15 software. The ANOVA consisted of 3 treatments, 3 horses and 3 periods as factors thus n=9, differences between means were determined using post-hoc least significant difference (LSD), $LSD = t [\text{error df}] \times \text{s.e.d}$, used to determine differences between means.

For Heart rate variability measurements data was analysed using Kubios HRV software (kubios.com). Data was then tabulated along with heart rate data into Microsoft Excel 2010 where mean and standard deviation were calculated. A one way analysis of variance test was also applied to the HRV and HR data. Differences between means were determined using least significant difference test (LSD) as detailed above.

In this study the method of HRV-analysis described is FFT (Fast Fourier Transform) rather than AR (Autoregressive). An FFT model of power spectral analysis was chosen as this has been shown to provide more accurate results when looking at LF/HF ratios in some human studies (Chemla *et al.*, 2004). It has also been a very powerful technique for assessing autonomic nervous activity in the horse (Kuwahra *et al.*, 1996). The power spectrum of the horse reflects that derived from humans, cats and dogs (Kuwahra *et al.*, 1996) showing two major peaks, one is mainly linked to the sympathetic activity (low frequency) and the other reflects the vagal activity (high frequency) (Akselrod *et al.*, 1981; Bernasconi *et al.*, 1998). Therefore, the ratio LF/HF is

an indicator of sympatho-vagal balance, which represents the stress level (Pagani *et al.*, 1986).

Other authors have chosen to measure levels of stress and anxiety by using time domain parameters such as RMSSD and SDRR, however results are more accurate using this form of analysis when data is collected over a longer period of time (24 hours) (Schmidt *et al.*, 2010; Von Borrell *et al.*, 2007). HR measurements were taken in 30 minute periods during this study so this method of analysis was not suitable.

Therefore, the low frequency/high frequency Ratio (LF/HF) was selected to assess the effect each feed treatment had on the parasympathetic and sympathetic branches of the central nervous system (Task Force of the European Society of Cardiology, 1996). The higher the ratio indicates dominance of the sympathetic over parasympathetic and vice versa, thus the change from rest to a highly stressed state (Task Force of the European Society of Cardiology, 1996). It has been used in a number of studies as an indicator of sympathetic activity during psychological and physical stressors in animals, although there is an ongoing debate about the suitability of HRV parameters to assess SNS activity, this approach produces reliable measures of vagal tone during both times of stress and at rest (Von Borrell *et al.*, 2007; Bachmann *et al.*, 2003; Rietmann *et al.*, 2004).

Time domain was also used, the mean heart rate for each horse was recorded over a 30 minute period. It was vital to ensure that the duration was the same in order to make comparisons, this was used in support of the HRV data but not solely relied upon because changes in heart rate can easily be due to external environmental stressors. A study by Rietmann *et al.*, (2004) uses mean HR successfully alongside frequency domain parameters to measure susceptibility to stress in horses.

3.2 Experiment 1 Results

3.2.1 Condition Score

Table 5 below shows the results of the condition scoring carried out on all horses.

Horse 1 was scored overweight, but Horse 2 and 3 were scored 'good' on the 11 point scale (Leighton, 1981). All horses remained the same weight throughout the duration of the study.

Table 5. Condition score of horses during a 9 week trial using the Leighton (1981) 11 point scale.

Horse	Pelvis Score	Back Score	Difference from Pelvis Score	Neck Score	Difference from Pelvis score	Adjustments	Condition Score
1	4	4	none	4	None	None	4
2	3	3	None	3	None	None	3
3	3	4	+1	2	-1	None	3

3.2.2 Measurements for Intake, bite rate, chews per minute, blink rate and behavioural initiation rate of three normal horses feeding from three feed treatments:

Although there was a 10.1 minute increase in overall intake time when comparing intake time for day 1 and at the end of each 3 week phase, the results were not significant. Thus no adaptation in terms of intake time was noted over a 21 day period when horses were fed hay from either a slow feeder, hay net or from the ground.

Blink rate was seen to reduce by 26.7 blinks in a 30 minute period between day 1 and day 3, although there were no significant differences found.

Chewing rate did increase by day 3 by 15.7 chews/ min, however no significant differences were found and therefore it can be concluded that no adaptation occurred over time.

All other parameters showed no significant differences, thus no adaptation to feed method was noted in any horse over each of the 21 day periods.

Table 6. Mean Intake time, Bites/min, Chews/Min, Hay intake g/min, Mins/kg and behavioural initiation rate and blink rate of stabled horses fed from the ground, from a hay net and from a slow feeder.

Data	Day 1	Day 2	Day 3	s.e.d	Sig Diff (P<0.05)
Intake Time (mins/2Kg)	63.4	60.9	53.3	4.22	NS
Bites per min	9.08	10.43	8.62	1.02	NS
Chews per min	68	78.2	83.7	3.39	NS
Hay intake g per min	32.1	34.9	39.8	3.01	NS
Consumption rate mins/ kg	28.89	29	26.67	2.15	NS
Blink Rate /30 mins	239.4	227.0	212.7	23.70	NS
BIR / 30 mins	5.67	6.11	5.11	1.04	NS

Figure 5 below shows a Box Plot graph of overall intake time when horses were fed from the ground, from a hay net and from a slow feeder. The graph shows a lot of variability within the data set, however there is a visible adaptation to feed method as intake time reduced in all horses when fed from the slow feeder on day 3 compared to day 1.

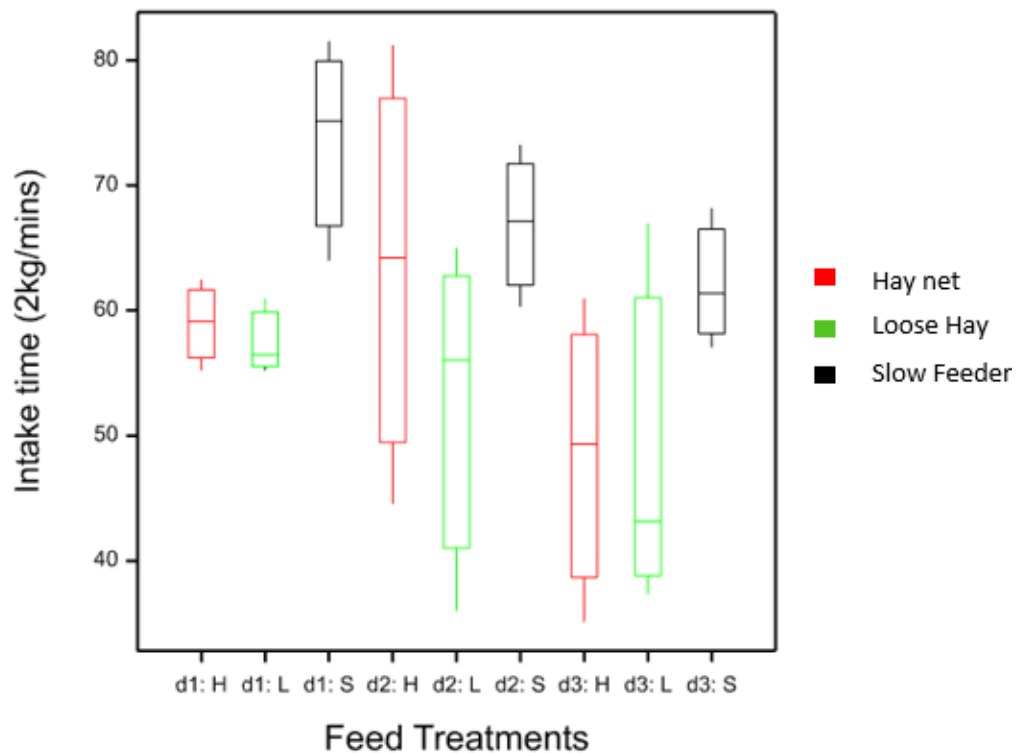


Figure 5. Box plot showing overall intake time of horses fed 2kg of hay from a hay net, from the ground and from a Slow Feeder over 3, 21 day periods.

3.2.3 Intake, bite rate, chews per minute and behavioural measurements and the effect presenting hay from the ground, in a hay net or in a slow feeder:

Results from this experiment revealed that bites per minute were 3.7 minutes higher (3.7 minutes) when horses ate from the hay net compared with the loose hay which was significantly different ($P < 0.05$). Bites per minute from the SF was 9.4 minutes which was not different from when hay was present either loose on the floor or from a hay net.

All other parameters measured show no significant differences between the 3 ways of presenting hay to stabled horses.

Table 7. Total intake time, g/min, mins/kg; bites /min and chews/min) and behavioural data (blink rate, behavioural initiation) data for 3 horses fed hay either loose, from a hay net or from a commercially designed slow feeder

Data	Loose Hay	Slow Feeder	Hay net	s.e.d	Sig Diff (P<0.05)
Intake Time (mins/2Kg)	52.9	67.6	56.9	6.17	NS
Bites per min	6.97a	9.43ab	10.67b	1.15	0.05
Chews per min	79.4	74	74.63	7.53	NS
Hay intake g per min	39.3	30	37	5.25	NS
Consumption rate / kg (mins)	26.7	33.7	28.7	2.98	NS
Blink Rate /30 mins	229.7	232.8	217.1	16.56	NS
BIR / 30 mins	5.67	6	5.22	1.52	NS

ab values = the same row not sharing common superscripts are significantly different (P<0.05).

3.2.4 Heart Rate and Heart Rate Variability:

Table 8 below shows the mean heart rate variability (LF/HF) across the three horses when fed hay either loose, from a hay net or from a slow feeder. Heart rate variability did not alter across treatments indicating that no method of feeding was stressful to the horses.

Table 8. Heart rate variability for 3 horses when offered 2 kg hay from the floor (loose), a slow feeder and from a hay net

Treatment	Loose	Slow feeder	Hay net	s.e.d	Sig Diff (P<0.05)
HRV (LF/HF)	2.24	1.96	1.68	0.541	NS

Individual heart rates are shown in Table 9 below. Mean heart rates ranged from 35 to 43 beats per minute across horses while mean treatment HR ranged from 38 to 40 beats per minute. Hay presented in the Slow feeder reduced HR by 9 beats per minute in horse one, but was seen to increase heart rate by 11 bpm in horse 2 and 6 bpm in horse 3 when compared to loose hay.

Individual heart rate variability data showed huge variation ranging from 1.22 to 2.91.

Higher HRV data is related to increased stress level.

Table 9. Mean Heart Rate (beats per minute) (+SD) for 3 Normal Horses when feeding hay loose from the ground, from a Slow Feeder and Hay net

Horse	Loose hay	Slow Feeder	Hay net	Mean ($\pm$ SD)
1	42.3	33.7	41.5	39.2 ($\pm$ 3.89)
2	38.8	49.4	42.7	43.7 ($\pm$ 4.37)
3	33.2	39.4	34.7	35.7 ($\pm$ 2.62)
Mean ($\pm$ SD)	38.1 ($\pm$ 3.75)	40.8 ($\pm$ 6.51)	39.6 ($\pm$ 3.52)	

Mean HRV data is shown below in Table 10. The LF/ HF ratio was higher when horse 3 was presented hay in a slow feeder compared to a hay net. Whereas horse 1 and 2 show highest levels when fed from a hay net. The higher the LF/HF ratio the higher the stress level in the animal.

Table 10. Mean Heart Rate Variability (LF/HF) (+SD) for all three horses fed all three feed methods

Horse	Mean HRV			Overall HRV Mean (+SD)
	Loose Hay	Slow Feeder	Hay net	
1	1.22	1.20	1.24	1.22 (<u>±</u> 0.37)
2	1.74	1.44	2.04	1.74 (<u>±</u> 0.42)
3	3.77	3.19	1.78	2.91 (<u>±</u> 1.89)
Standard Deviation	1.10	0.33	0.89	

3.3 Experiment 1 Discussion

All horses used for the duration of this trial remained healthy. The primary findings from the current study show that offering horses hay from either a hay net or a slow feeder only influences the bites per minute parameter. Hay nets appear to restrict the size of mouthful a horse can grasp, which then stimulates the horse to take more bites than when they were feeding from either the slow feeder or loose hay off the ground. However, there was evidence which showed that intake time was increased when feeding from the slow feeder with the mean time taken of (67.6mins) being 14.7 minutes and 10.7 minutes longer than loose hay and hay net respectively. Showing that the slow feeder had a positive effect on the rate of intake and was able to slow down the consumption of hay.

The number of days and thus time each horse had been exposed to a feed method also influenced intake time, although not significantly. Work by Ellis *et al.*, (2012) suggested that horses require 5 days to acclimatise to new feed treatments before behavioural observation. Data from this experiment showed that by day 11 horses were consuming forage 10.1 mins faster than when data was collected on day 1. Showing evidence that horses do adapt to new feed methods after a few days as described by Ellis *et al.*, (2012).

In addition, chewing rate was seen to increase over time, day 1 average chews per minute for all horses across all feed treatments was 68 and by day 21 of each phase chews had increased to 83.7 per minute. This was a positive result and again shows that horses learnt to adapt to each new method of feeding. Chewing rate is linked to the production of saliva which with its buffering capacity is vital for reducing gut acidity and aiding digestion (Rafat *et al.*, 2009).

Furthermore, the behavioural measurements from this study indicate that this slowing- down process does not cause any additional stress to the horse.

An additional trend was observed when looked at SBR which was slightly higher when horses were fed from the slow feeder or loose hay compared with the hay net. This slight increase could be due to the novelty of this method of feeding all study horses would normally be presented with forage in a hay net. However when looking at SBR over time, blink rates were lower by day 21 showing an adaptation to feeding and reduction in stress. This was a positive result as significant increases in SBR have been linked to increased dopamine release, tension and stress (Drinkwater, 1968; Garner and Mason, 2002; Garner *et al.*, 2003).

Mean heart rates differed between individuals (35-43bpm) and between treatments (38-40bpm). Horse 2 displayed a higher heart rate when feeding from the slow feeder (49.4bpm) compared to loose hay (38.8bpm) and hay net (42.7). Similar results were found in Horse 3 slow feeder (39.4bpm), loose hay (33.2 bpm) and hay net (34.7bpm) however, in Horse 1 heart rate was reduced by 9 bpm when hay was presented in a slow feeder, showing the individual variability between horses.

Heart rate is easily affected by environmental conditions such as weather and activity on the yard. The HRV data was used to establish whether an elevation in heart rate indicates stress induced by change in feed method and restricted access to forage. The results from this experiment do not show any significant differences and therefore it can be concluded that there was no additional stress to the horse.

Heart rate variability was assessed by using the frequency domain parameter, Low Frequency: High Frequency (LF/HF). This ratio represents the stress level of the animal. The high frequency component (HF) was overall dominant in all horses during feeding,

reflective of activity in the parasympathetic pathway (rest), which would indicate horses were not stressed. Horse 2 displayed an elevation in the LF component of the ratio during feeding from a hay net on one occasion (2.04) and Horse 3 when feeding from the slow feeder (3.19). This could have been down to novelty of the method as horse 2 was normally fed from the ground and horse 3 would normally receive forage in a hay net. Horse 1 hardly displayed any differences in either HR or HRV between treatments which shows the individual variability of the data set and the need for further research with a larger population of horses.

Although overall it has been concluded from the behavioural data that the SF and restricted access to forage does not cause stress to the animal. It must be noted that in one horse HRV, blink rate and heart rate were increased when feeding from this method which could be indicative of stress and anxiety. Further research is warranted to establish whether this was due to the individual, novelty of the device or due to restricted access to forage and subsequently whether this affects the animal's welfare. The lack of significant results in this data set may also be due to the small number of horses and treatments used (n=3).

Research by Hallam *et al.*, (2012) found that a novel all-inclusive feed bin system (Slow Feeder) had a positive effect on both intake time and behaviour in the stable. Despite, no significant results in this study it can be concluded that feeding horses from a slow feeder compared to conventional methods such as a hay net or loose from the ground does not cause any additional stress or alter stable behaviour. Furthermore a trend in the data shows that feeding horses forage from a slow feeder increases intake time and chewing rate.

3.4 Methodology Experiment 2

3.4.0 Study Population

All horses remained healthy throughout the duration of this study.

In order to carry out this research 4 hyper reactive horses were used (2 mares and 2 geldings). The mean height of the horses at the withers in cm was 163.7 (Range 159-170.2) which is displayed in Table 4. The mean age of the horses in the group was 7 (Range 5-10).

Variability in gender, age and temperament is important to ensure that the data can be representative of the equine population as a whole.

Table 11. Study Population Experiment 2

Horse Number	Age	Height (cm)	Weight (kg)	Gender	Discipline
1- Cameron	10	170.2	580	Gelding	Showjumper
2 – Pepsi	5	159	564	Mare	Showjumper
3- Rupert	5	161	552	Gelding	Showjumper
4- Helga	7	165	598	Mare	Showjumper

3.4.1 Experimental Design

The experiment was carried out as a 4x4 Latin square design thus treatment, period and horses differences were accounted for.

Experiment 2 was carried out on 4 Hyper reactive horses, each horse was fed 4 feed treatments, loose hay from the ground, small holed hay net, from the Haygain slow feeder (novel all-inclusive feed bin) with easy regulator and from the Haygain slow

feeder with standard regulator. Each horse was fed each feed treatment for 2 weeks, the trial was completed in 8 weeks.

Table 12. 4x4 Latin Square used in Experiment 2.

Feed Treatment	Hay net	Loose hay	Slow Feeder 'Easy Regulator'	Slow Feeder 'Standard Regulator'
Period				
1	H1	H2	H3	H4
2	H4	H1	H2	H3
3	H3	H4	H1	H2
4	H2	H3	H4	H1

(H1 = Horse 1, H2=Horse 2, H3=Horse 3, H4=Horse 4)

3.4.2 Management Regime

All horses were stabled with exercise periods restricted to dry-lot turnout, ridden exercise, use of the horse walker and lunging. Stables were fully matted (8X10ft), with automatic drinkers, horses were bedded on shavings and fed hay post steaming in a HG2000 in feed amounts based on 2.3 % bodyweight.

Morning concentrate feeds were given at 8am, hay rations were fed at 9am and all data was collected before noon. Evening concentrate feeds were fed at 5pm and hay was given at 5.30pm.

3.4.3 Data Collection

In order to account for acclimatisation period measurements were taken at the beginning, middle and end of each feed treatment period in order to account for any adaptation to the feed treatments.

For phase one of the trial numerical data was recorded for feed intake behaviour (intake time, bite rate, chews /minute) on Day 1, 7 and 14 of each 2 week period. Behavioural output data (heart rate, heart rate variability, behavioural initiation rate per 30 minutes , spontaneous eye blink rates per 30 minutes) was recorded on Day, 2, 8, and 13.

3.4.4 Condition Score and Weight Estimation

The Condition scoring system used (Leighton, 1981) assessed the amount of subcutaneous fat over the hindquarters by applying a scale of points from 0 to 5, zero indicates very poor and 5 grossly obese. Half scores are used in between to give an 11 point scale. In order to get an accurate condition score, visual assessment must be accompanied by manual inspection (Leighton, 1984).

Three areas are assessed for scoring:

- 1) Pelvis and top of the quarters
- 2) Back bone and ribs
- 3) Base of the neck

The pelvis score is adjusted by half a point or more if it differs from the back and neck scores to give the condition score.

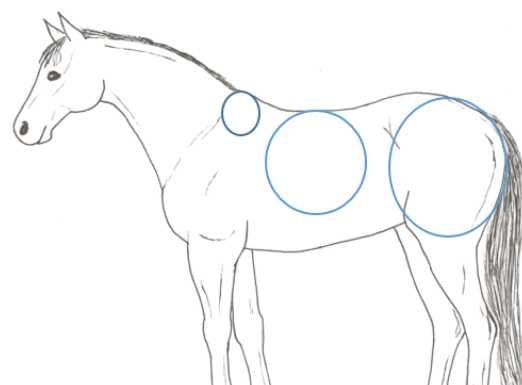


Figure 6 Areas Assessed in Condition Scoring

In order to assess live weight of each animal a Spillers Weigh tape (Spillers Feeds, 2016) was used.

3.4.5 Intake time, Bites and Chews per Minute

On day 1, 7, 14 each horse was fed 2kg of steamed hay and intake time was measured using a stop watch (Karrimore Run Stopwatch, 2016). Horses were left to acclimatise to

the feed treatment for 5 minutes prior to data collection. At the beginning, middle and end of feeding, bite rate per 30 minutes and number of chews per minute were recorded using a hand held tally counter (Jazooli, 2016). To ensure data was collected accurately, bite and chew rate was recorded in 4 x 15 second periods to total 1 minute.

3.4.6 Heart Rate and Heart Rate Variability

Heart rate was measured using a Polar V800 Heart Rate Monitor (Polar Equine, 2016). The HR monitor consisted of an electrode belt that picked up the electrical activity of the horse's heart. A transmitter attached to the belt enabled wireless communication of the HR to a wrist watch receiver. The belt was fitted around the horse's thorax and secured with a surcingle. Both electrodes were placed to the left-hand side of the horse. One electrode was placed approximately 10 cm below the withers, and the other 10 cm behind the elbow over the heart (see Fig 7).

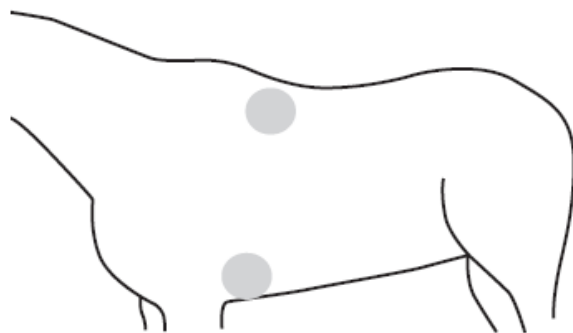


Figure 7. Electrode Placement (Polar Equine, 2016)

Warm water and KY lubricant jelly were used to optimise contact between the horse's skin and the electrodes. The wrist watch receiver was attached to the surcingle to ensure it remained within signal range. All horses were given 10 mins to habituate to the equipment according to the methods of Ellis *et al.*, (2015) and Youngs *et al.*, (2012).

Heart rate was measured for 30 minutes during morning feeding on day 2, 8 and 13 of each 2 week period. Baseline heart rate was recorded 3 days prior to the start of the trial to ascertain a mean HR. The baseline data collection method for experiment 2 was amended due to high baseline HR and SBR recorded during experiment 1 when horses stood in the wash box. Higher HR and SBR was indicative of increased stress when compared to levels ascertained during feeding, making comparisons difficult. Therefore horses were left in their stables without access to forage during baseline data collection.

3.4.7 Spontaneous Eye Blink Rate

All horses were given their morning hay and SBR was recorded during a 30 minute period using a hand tally counter. Spontaneous eye blink rate (SBR) as defined by Karson (1983) is the bilateral paroxysmal brief repetitive eye closures occurring continuously. Considering the anatomy of the horse, true bilateral eye closures would be difficult to measure therefore only the left eye was observed for all horses.

Horses were observed in their box, on day 2, 8 and 13, three repetitions were taken to ascertain mean SBR. Baseline SBR was recorded in a 30 minute periods on the 3 days prior to the trial start day, during these observations horses stood in their stables with no access to forage.

3.4.8 Behavioural Initiation Rate (BIR)

Behavioural initiation rate was recorded in a 30 minute period, from 18.30-19.00 approximately one hour after evening feeding to establish BIR during each feed treatment without the presence or interference of humans. This observation was

repeated three times (Day 2, 8, 13) to establish a mean behavioural initiation rate for each horse during each feed treatment.

All behaviours were defined and documented using an existing ethogram, however only number of behavioural transitions were recorded. Notes were made with regard to type of behaviour observed to assist analysis. Each bout of behaviour was recorded as a new initiation regardless of the previous behaviour, for example the sequence 'Feeding- Drinking- Standing at Rest –Feeding- Grooming' would be recorded as 4 behavioural initiations.

The behaviour of the subjects was recorded 24 hours a day using a Swaan DVL8-4150 CCTV (Maplin Electronics, 2016) unit secured at ceiling height in the corner of each stable in an appropriate position to gain an adequate field of view. The CCTV cameras were linked to a smart phone application in order to monitor feeding behaviour at all times and assist in the measurement of BIR.

3.4.9 Data Analysis Experiment 2

Data analysis was carried out in two parts. Firstly, in order to establish whether there was any adaptation to feed method between data collected at the beginning, middle and end of each 2 week phase a repeated measures analysis of variance was carried out using Genstat 15 software. Secondly, in order to establish the effect each feeding treatment (hay net, slow feeder with easy regulator, slow feeder with standard regulator and loose hay) had on both intake and behavioural parameters a one way analysis of variance was carried out.

Repeated Measures Analysis of Variance

All raw intake data (intake time, chews per minute, bites per minute) and behavioural initiation rate and spontaneous eye blink rate were tabulated into spreadsheets using Microsoft Excel (2010), where descriptive statistics were applied (mean, standard deviation) for all horses (n=4). Four treatments, Four horses and Four periods were used as factors thus n=12, with a post-hoc least significant difference (LSD), $LSD = t [\text{error df}] \times \text{s.e.d}$ used to determine differences between means.

One Way Analysis of Variance

All raw intake data (intake time, chews per minute, bites per minute) and behavioural initiation rate and spontaneous eye blink rate were tabulated into spreadsheets using Microsoft Excel (2010), where descriptive statistics were applied (mean, standard deviation) for all horses (n=4). A one way analysis of variance was carried out using Genstat 15 software. The ANOVA consisted of 4 treatments, 4 horses and 4 periods as factors thus n=12, with a post-hoc least significant difference (LSD), $LSD = t [\text{error df}] \times \text{s.e.d}$ used to determine differences between means.

For Heart rate variability measurements data was analysed using Kubios HRV software (kubios.com). Data was then tabulated along with heart rate data into Microsoft Excel 2010 where mean and standard deviation were calculated. A one way analysis of variance test was also applied to the HRV data. Differences between means were determined using least significant difference test (LSD) as detailed above.

In this study the method of HRV-analysis described is FFT rather than AR. An FFT model of power spectral analysis was chosen as this has been shown to provide more accurate results when looking at LF/HF ratios in some human studies (Chemla *et al.*,

2004). It has also been a very powerful technique for assessing autonomic nervous activity in the horse (Kuwahara *et al.*, 1996). The power spectrum of the horse reflects that derived from humans, cats and dogs (Kuwahara *et al.*, 1996) showing two major peaks, one is mainly linked to the sympathetic activity (low frequency) and the other reflects the vagal activity (high frequency) (Akselrod *et al.*, 1981; Bernasconi *et al.*, 1998). Therefore, the ratio LF/HF is an indicator of sympatho-vagal balance, which represents the stress level (Pagani *et al.*, 1986).

Other authors have chosen to measure levels of stress and anxiety by using time domain parameters such as RMSSD and SDRR, however results are more accurate using this form of analysis when data is collected over a longer period of time (24 hours) (Schmidt *et al.*, 2010; Von Borrell *et al.*, 2007). HR measurements were taken in 30 minute periods during this study so this method of analysis was not suitable.

Therefore, the low frequency/high frequency Ratio (LF/HF) was selected to assess the effect each feed treatment had on the parasympathetic and sympathetic branches of the central nervous system (Task Force of the European Society of Cardiology, 1996). The higher the ratio indicates dominance of the sympathetic over parasympathetic and vice versa, higher the sympathetic activity indicates increased stress level in the animal (Task Force of the European Society of Cardiology, 1996). It has been used in a number of studies as an indicator of sympathetic activity during psychological and physical stressors in animals, although there is an ongoing debate about the suitability of HRV parameters to assess SNS activity, this approach produces reliable measures of vagal tone during both times of stress and at rest (Von Borrell *et al.*, 2007; Bachmann *et al.*, 2003; Rietmann *et al.*, 2004).

Time domain was also used, the mean heart rate for each horse was recorded over a 30 minute period. It was vital to ensure that the duration was the same in order to make comparisons, this was used in support of the HRV data but not solely relied upon because changes in heart rate can easily be due to external environmental stressors. A study by Rietmann *et al.*, (2004) uses mean HR successfully alongside frequency domain parameters to measure susceptibility to stress in horses.

3.5 Experiment 2 Results

3.5.1 Condition Score

Table 13. Condition score of horses used throughout an 8 week study using the Leighton (1981) 11 point scale.

Horse	Pelvis Score	Back Score	Difference from Pelvis Score	Neck Score	Difference from Pelvis score	Adjustments	Condition Sore
1	4	3	-1	4	None	-½	3 ½
2	3	3	None	3	None	None	3
3	2	2	None	2	None	None	2
4	4	3	-1	3	-1	+½	3 ½

3.5.2 Measurements for Intake, bite rate, chews per minute, blink rate and behavioural initiation rate of four horses feeding from four feed treatments:

Overall intake time of 2kg hay, when presented in a hay net, on the ground or in a slow feeder on day 1 was significantly different when compared to day 14. Horses acclimatised to each feed method thus intake time decreased by 14.5 minutes over the 14 day test period.

Bite rate was significantly increased between day 1 and 14 ($P < 0.05$) showing further evidence of acclimatisation.

No significant differences were found for behavioural initiation rate or blink rate during the 14 day period that each horse fed from each feed treatment, showing no additional stress to the horse.

Table 14. Total Intake time (Hay intake g/min, Mins/kg) Bites/min, Chews/Min, behavioural initiation rate and blink rate of hyper reactive stabled horses fed from the

ground, from a small holed hay net, from a slow feeder with standard regulator and from a slow feeder with easy regulator

Data	Day 1	Day 7	Day 14	s.e.d	Sig Diff (P<0.05)
Intake Time (mins/2Kg)	69.9b	61.7b	55.1a	2.98	<0.001
Bites per min	11.88a	12.14ab	12.85b	0.36	<0.04
Chews per min	73.75	78.13	78.84	2.31	NS
Hay intake g per min	32.26	36.75	38.19	2.35	NS
Consumption rate mins/ kg	34.25b	29.69a	27.50a	1.59	<0.001
Blink Rate /30 mins	569.8	557.4	569.8	10.63	NS
BIR / 30 mins	7.81	9.75	10.62	1.41	NS

abc values = the same row not sharing common superscripts are significantly different (P<0.05).

Figure 8 below shows a Box Plot graph of overall intake time when horses were fed from the ground, from a hay net and from a slow feeder with both an easy and standard regulator configuration. The graph shows a visible adaptation to feed method as intake time reduced in all horses significantly between day 1 and 14 when fed from all feed methods (P<0.001).

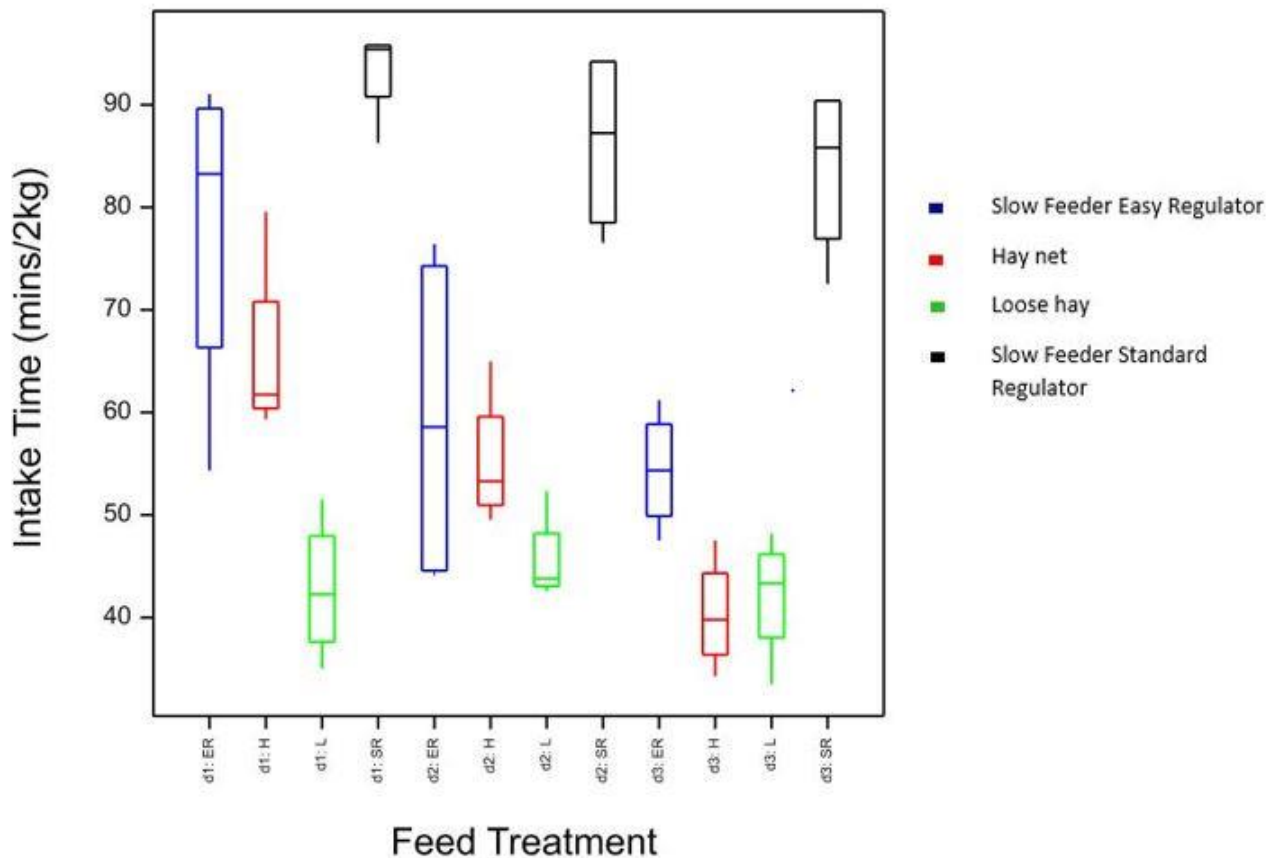


Fig 8. Box Plot Graph for Intake times on day 1, 7 and 14 when 2kg hay was presented in a slow feeder with easy and standard regulators, loose on the floor and in a hay net

3.5.3 Intake, bite rate, chews per minute and behavioural measurements and the effect presenting hay from the ground, in a hay net or in a slow feeder with two different regulators has on these parameters:

Intake time, g/min and mins/kg data revealed that the slow feeder significantly reduced intake time compared to when hay was presented loose on the ground or from a hay net ($P < 0.001$). Significant differences were also found between the intake times of the slow feeder with standard regulator compared to slow feeder with easy regulator, total difference of 12.2 mins/kg. However, no significant interactions were found between time and treatment.

Bites per minute were significantly lower when horses ate hay loose from the ground compared to other methods of presenting forage, with a difference of 6.15 bites/min.

No significant differences were found for either behavioural initiation rate or blink rate when hay was presented to hyper reactive horses in a hay net, on the floor or from a slow feeder.

Table 15. Intake data (total intake time, g/min, mins/kg; bites /min and chews/min) and behavioural output (blink rate, behavioural initiation) data for 4 hyper reactive horses fed hay either loose, from a hay net or from a commercially designed slow feeder with standard or easy regulator

Data	Loose Hay	Hay net	Slow Feeder Easy	Slow feeder Standard	s.e.d	Sig Diff (P<0.05)
Intake Time (mins/2Kg)	43.5a	50.1a	63.4b	87.7c	4.98	<0.001
Bites per min	8.25a	13.22b	14.4b	13.75b	1.33	<0.004
Chews per min	77.5	76.6	77.0	76.6	3.46	NS
Hay intake g per min	46.75a	41.25a	33.25c	22.75b	2.80	<0.001
Consumption rate / kg (mins)	21.50a	25.25a	44.0c	31.75b	2.57	<0.001
Blink Rate /30 mins	556	543	575.3	578.2	17.5	NS
BIR / 30 mins	7.1	25.6	9.2	9.9	9.89	NS

abc values = the same row not sharing common superscripts are significantly different (P<0.05).

The overall mean intake times for all horses when hay was presented loose on the floor, from a hay net or in a slow feeder with two regulators are shown in the box plot below. Intake time when feeding from a slow feeder was significantly longer, thus more time spent feeding, compared to all other methods ($P < 0.001$)

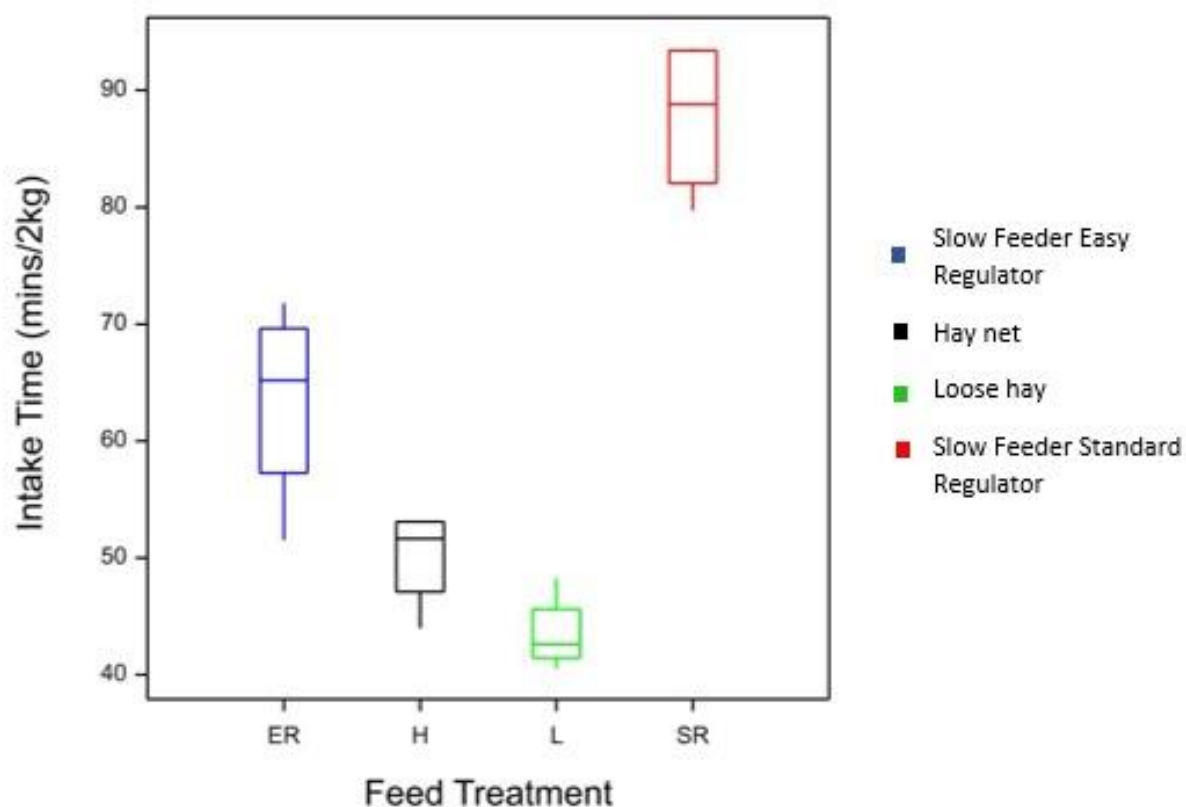


Fig 9. Mean intake times for four hyper reactive horses fed 2kg hay in a hay net, slow feeder and from the ground.

3.5.4 Heart Rate and Heart Rate Variability

Mean baseline heart rates for each horse taken in the stable for 30 mins in the absence of forage. Baseline HRV levels were high for all horses (2.95-5.22) and there was a lot of variability in the HR data (24-100bpm).

Table 16 Baseline heart rates (30mins) of four hyper reactive horses

Baseline Mean Heart Rates and HRV (LF/HF) / 30mins				
Horse	Min	Max	Mean	HRV (LF/HF)
1	28.67	57.67	44.09	2.95
2	26.33	86.33	48.43	4.74
3	24	100	47.93	5.22
4	30	84.3	41.87	2.98

Table 17 below shows the mean heart rate variability (LF: HF) across for all four horses when fed hay either loose, from a hay net or from a slow feeder with standard or easy regulator. Heart rate variability did not alter significantly across treatments indicating that no method of feeding was stressful to the horses.

Table 17. Heart rate variability for 4 hyper reactive horses when offered 2 kg hay from the floor (loose), a slow feeder with two regulators and from a hay net analysed using ANOVA

Treatment	Loose	Hay net	Slow Feeder Easy	Slow Feeder Standard	s.e.d	Sig Diff (P<0.05)
HRV (LF/HF)	3.42	3.67	5.64	4.3	1.06	NS

Individual heart rates are shown in Table 18 below. Mean heart rates ranged from 44.9 to 54.7 beats per minute across horses while mean treatment HR ranged from 41.8 to 52.3 beats per minute. Hay presented in the slow feeder with easy regulator reduced HR by 0.8 beats per minute in horse 4, but was seen to increase heart rate by 1.11 bpm in horse 1, 5.8 bpm in horse 2 and 26.9 bpm in horse 3 when compared to loose hay. Hay presented in the slow feeder with standard regulator increased HR in all horses by an average of 10.5bpm.

Table 18. Mean Heart Rate (beats per minute) (+SD) for 4 hyper reactive Horses when feeding hay loose from the ground, from a Slow Feeder with two regulators and a Hay net

Mean Heart Rates/30 mins					
Horse	Loose Hay	Hay net	SF Easy	SF Standard	Mean (+SD)
1	42.28	46.25	52.62	43.39	46.1(+4.01)
2	39.4	41.6	53.57	45.21	44.9 (+5.39)
3	40.7	54.49	55.91	67.59	54.7 (+9.53)
4	45	52.74	47.06	43.8	47.2(+3.43)
Mean + SD	41.8 (+2.1)	48.8 (+5.2)	52.3 (+3.2)	50.0 (+10.2)	

Mean HRV data is shown below in Table 19. There was a lot of variation between horses and between feed treatments. Horse 3 displayed extremely high HRV particularly when feeding from the SF with easy regulator (11.15) compared to all other methods and all other horses, showing the individual variability. Lowest levels were seen when hay was presented on the floor (3.4). The higher the LF/HF ratio the higher the stress level in the animal.

Table 19. Mean HRV (LF/HF) data taken over 30 mins for each horse during each feed treatment

Mean HRV (LF/HF) / 30 mins					
Horse	Loose Hay	Hay net	SF Standard	SF Easy	Mean $\pm$ SD
1	1.93	2.7	2.48	4.06	2.8 ($\pm$ 0.78)
2	3.33	2.75	4.16	4.23	3.6 ($\pm$ 0.61)
3	6.08	4.71	5.99	11.15	7.0 ($\pm$ 2.47)
4	2.36	4.52	4.58	3.11	3.6 ($\pm$ 0.95)
Mean ($\pm$ SD)	3.4 ($\pm$ 1.61)	3.7 ($\pm$ 0.95)	4.3 ($\pm$ 1.25)	5.6 ($\pm$ 3.21)	

3.6 Discussion Experiment 2

3.6.1. Intake Time, Bites and Chews per minute

All horses remained healthy throughout the duration of this trial. The primary findings from Experiment 2 show that offering horses hay in a hay net, from a slow feeder with two sized regulators and loose from the ground influences intake time (total intake, mins/kg, g/min) and bites per minute. Chewing rate was not affected by either time or treatment (range 77.5-76.6 chews/min). Meyer *et al.*, (1975) found horses chew on average once per second when consuming forage so these results are in similar to this finding.

The configuration of the slow feeder regulator encourages horses to 'nibble' through various sized holes to access hay, to encourage natural foraging behaviour. This feed method increased feeding time and the restricted access to forage encouraged horses to take more bites. Intake time was significantly increased when horses were fed from the slow feeder compared to a hay net (50.1 mins/2kg) or loose hay (43.5 mins/2kg) and further increases in feeding time were seen when hay was presented in the slow feeder with standard regulator (87.7 mins/2kg) compared to the easy regulator (63.4 mins/kg). This is potentially a very valuable finding as increased foraging opportunity and feeding time have been linked to a reduction in the onset of undesirable stereotypies such as weaving and crib-biting (Stanley *et al.*, 2015; Wickens and Helenski, 2010). Furthermore, the prevalence, type and severity of gastric ulcers (EGUS) have also been linked to forage intake and diet composition (Murry *et al.*, 1996; Smyth *et al.*, 2011; Orsini, 2000). Trickle feeding of forage reduces the incidence of EGUS, particularly squamous ulcers (ESGU) as the squamous region of the stomach lacks the bicarbonate layer which protects against acid damage, therefore ulcers in this

region are often caused when acid splashes up from the glandular region. Lack of feeding reduces the buffering capacity and increases the likelihood of ulceration (Murry *et al.*, 1996; Smyth *et al.*, 2011; Orsini, 2000).

3.6.2 Acclimatisation to Feed Method

Ellis *et al.*, (2015) suggested that horses require 5 days adaptation to a new feed treatment, in order for horses to achieve optimum efficacy in removing hay. In this study, horses acclimatised to each feed method within the first week. Over each 14 day test period, intake time increased on average by 14.5 minutes as horses adapted to new feeding methods.

Horses in this study were fed from each method of feeding twice a day (morning and evening) which could have potentially increased the speed at which they acclimatised. Results from a hay net trial by Glunk *et al.*, (2013) which utilised only 2 days acclimatisation showed a greater effect of hay net whole size on feed intake time, than results from Ellis *et al.*, (2015) trial. Results from this study would suggest that the study conducted by Glunk *et al.*, (2013) had an insufficient acclimatisation period in order to obtain an accurate effect of feeding from a hay net. This current study took into consideration the suggested acclimatisation period set out by Ellis *et al.*, (2015) by recording measurements for intake and behaviour at the beginning, middle and end of each period.

3.6.3 Behavioural Parameters

The behavioural measurements from this study indicate that changing feed method and restricting access to forage does not cause any additional stress to the horse.

Blink rate did not alter between individuals, feed treatments or when comparing them to baseline levels. A significant increases in SBR has been linked to increased dopamine release, muscular tension and stress (Drinkwater, 1968; Garner and Mason, 2002; Garner *et al.*, 2003), any increase in these parameters would be undesirable.

HRV was used in this study as psychological stress may impact sympatho-vagal balance (LF/HF) in the absence of any physical changes in heart or respiration rate (Von Borell *et al.*, 2007). HRV has also been used to quantify specific aspects of a horse's temperament and this parameter has proven to be a useful indicator of temperament in horses (Visser *et al.*, 2002; Von Borell *et al.*, 2007). Increased HRV was associated with high BIR score and abhorrent behaviours in this study group. Initially feeding from a slow feeder or hay net, caused an elevation of the sympatho-vagal balance (LF/HF) reflecting the alteration of the ANS from rest to a more stressed state (Reitmann *et al.*, 2004).

Increased BIR has been associated with stress and dopamine level, and stereotypic animals across a range of species have higher BIR than control animals (Garner and Mason, 2002; Roberts *et al.*, 2015). The type of behaviour exhibited can be used to assess stress level and flight response. High stress related behaviours such as: agitated, fidgety, anxious, active and aggressive, weaving, box walking, repetitive head movements, stamping or kicking with hind feet and snorting (Young *et al.*, 2012). All of which have been seen in the sample group studied, indicating that introduction of a novel feeding device does induce negative behaviours within the first few days. However after this period of acclimatisation the opposite occurred and when horses fed for longer they were more relaxed and exhibited less agitated behaviours

3.6.4 Individual Horse Behaviour

The horses used in this study were hyper reactive in nature but all differed in temperament, age and experience. Lowest levels of behavioural data (SBR, HR/HRV) were seen in horse 1, heart rate data was fairly consistent throughout all feed methods (mean 46.1bpm). Mean HRV (LF/HF) across all treatments was 2.8 which was lower than the baseline level (2.95). Thus indicating that feeding reduced sympathetic activity. These results show that different ways of presenting forage did not cause additional stress to this horse. Lower HR, sympatho-vagal balance (LF/HF) and SBR may be explained by the stereotypy behaviour observed, as this horse was seen to wind suck around meal times, which causes release of dopamine which relaxes the horse so the behaviour may have been acting as a coping mechanism for the suboptimal environment (Bachmann *et al.*, 2003). Behavioural initiation rates were highest in this horse (mean 11.4 BIR/30mins), as this horse frequently switched from feeding to windsucking during observations. This finding is in support of BIR data in stereotypic performing animals, where higher scores were recorded in comparison to controls (Garner and Mason, 2002; Roberts *et al.*, 2015)

Horse 2 showed aggression during handling and had to be removed from the stable when being mucked out or fed. Heart rate reduced in this horse during feeding from 48.4 bpm to 44.9bpm, but did increase to 53.6 bpm when fed from the slow feeder. This increase could be indicative of stress although the environment strongly influenced the behaviour of these horses, so the HRV (LF/HF) figure must be used to determine the cause of increased HR and whether it has caused stress or anxiety. When looking at the mean HRV (LF/HF) the figure was 3.6, which is lower than baseline levels (4.7) and the HF component is dominant, therefore it can be concluded that the

elevation in heart rate was more likely due to external influence on the day, such as weather or activity on the yard. Overall the BIR score for this horse was 5.6 (BIR/30mins), behaviour improved throughout the trial. During the first week of feeding from the slow feeder aggression reduced and the slow feeder was filled whilst the horse remained in its box, thus the slow feeder produced a positive effect on this horse.

Horse 3 was extremely highly strung, young, nervous and unsettled in the stable. He was observed box walking and throwing himself around within the stable, normally he would be turned out as much as possible because of this. Baseline heart rate in this horse ranged from 24-100bpm which can be related to his temperament. Mean HR increased during feeding when hay was presented in the SF (mean 61.8bpm) or in a hay net (mean 54.5bpm), HR reduced when hay was fed on the floor (40.7bpm) this was the normal method of feeding and may explain the differences noted. Baseline HRV (LF/ HF) for this horse was 5.2 the highest level seen across all horses and shows that this horse was more stressed in the stable environment. When fed from the slow feeder the LF/HF ratio was increased further to 11.2 which would show increased sympathetic activity in the ANS (autonomic nervous system), shown in the high LF component of the ratio and therefore increased stress and flight response in the animal (Reitmann *et al.*, 2004). The second highest HRV figure was recorded for this horse when hay was presented loose on the floor, this shows that other elements of the stable environment may have been adding to the stress level of the animal aside from feed method. Average BIR score was the second highest of all horses at 10.8 initiations per 30 mins, initially this horse refused to eat from the slow feeder and stood at the back of its box snorting. Observations on day 2 when hay was presented

in the slow feeder and hay net revealed the horse displaying frustration behaviours such as box walking, repetitive oral and exploratory as well as frequently looking over the stable door or out the window (Youngs *et al.*, 2012). When feeding from the standard slow feeder BIR score on day 2 was 25 and from the hay net 17, more than 3 times more initiations than when offered hay from the floor (BIR score 6/30mins) no frustration behaviours were observed during floor feeding. However, BIR levels reduced as this horse acclimatised to the slow feeder, by day 14 of the standard regulator BIR score had reduced to 12 and further evidence of this is seen when looking at mean data from the easy regulator (BIR score 7/30mins) this regulator was used on the slow feeder after the initial 2 week testing of the standard grid so the horse had worked out how to use it.

Horse 4 was also aggressive in her box. She was observed exhibiting frustration, high stress behaviours such as wall kicking, door kicking, pawing the ground and kicking the slow feeder (Youngs *et al.*, 2012). Heart rate for this horse was highest when feeding from a hay net, although feeding from all methods increased overall HR when compared to baseline averages. When looking at stress level, the HRV (LF/HF) ratio was highest when feeding from the standard regulator (4.6) and hay net (4.5), compared to baseline levels of 2.9. However, in both cases the high frequency component was elevated and therefore although more activity was noted in the sympathetic pathway during feeding, the horse was in a state of rest. Behaviours observed for this horse were abhorrent, Figure 10 below shows damage to the stable wall caused by kicking when fed from the hay net and loose hay, this behaviour was observed on CCTV post feeding. This behaviour was not observed during or post

feeding from the slow feeder although, pawing and kicking of the feeder was seen during week 1.



Figure 10. Damage to stable wall

Behavioural initiations were highest when feeding from a hay net (12.3) and the SF with easy regulator (13.0) and she was noticeably more unsettled during acclimatisation to these methods when comparing BIR score during loose hay feeding (BIR score 3). Overall, increased feeding time (use of the SF) influenced the stabled behaviour of this horse in a positive way. Aggression and BIR reduced once acclimatised to the slow feeder and she seemed to psychologically benefit from increased eating time. However HRV (LF:HF) levels during feeding from all methods except loose, remained higher than baseline which would be indicative of stress and anxiety, a longer term study to establish whether this was due to novelty of the feeder, individual horse, or due to restricted access to forage would be beneficial.

3.6.5 Behavioural Conclusions

Overall a trend was observed for BIR, particularly high when feeding from a hay net (25.6), this could be due to the novelty of method as all horses would normally be fed

from the ground. The un-natural feeding position and restricted access to forage could also have contributed to this. CCTV observations showed huge variation in type of behaviour over the 9 week period. Abhorrent behaviours, wall kicking, aggression, pawing and box walking were all witnessed during the first few days of feeding, when horses were fed their evening hay ration from the slow feeder. Again this could be due to novelty of the device as initiations reduced after 7 days as horses acclimatised to each method. No frustration behaviours were seen between day 7 and 14 of testing.

There was huge variability between horses, baseline HR levels ranged from 24- 100, this was in keeping with the temperament of the 'hyper reactive horses' as all horses had a very active flight response, were all nervous and on edge at all times. During feeding mean heart rates ranged from 44.9 to 54.7 bpm across horses and between 41.8 and 52.3bpm when comparing treatments. When hay was presented in a slow feeder with standard grid, heart rates were seen to increase in all horses. This could be indicative of stress, but due to the nature of the horses, this elevation is more than likely also related to environment on the day. Heart rate variability data was analysed in order to further assess the stress level of each horse during feeding. Although, it has been concluded from the behavioural data that the SF, and restricted access to forage does not cause stress to the animal. It must be noted that acclimatisation and exposure to a feed method did influence the stress level of the animal in some cases, higher HRV (LF/HF) and therefore increased sympathetic activity within the ANS were seen in the first 7 days of feeding, indicative of stress, when fed from the slow feeder compared to a hay net or loose.

Due to the variability between individual horses this data only provides a snap shot of the wider equine population. Research by Hallam *et al.*, (2012) found that a novel all-

inclusive feed bin system (Slow Feeder) had a positive effect on both intake time and behaviour in the stable. This study has backed up this finding, with significant differences in both intake time and bite rate when feeding from a slow feeder compared to hay net or loose hay. No significant differences were found between BIR score, SBR or HR/HRV across all feed methods, indicating no additional stress was caused to the animal and the SF had a positive effect on the type of behaviour exhibited in hyper reactive stabled horses.

Further research on a wider population particularly with regard to equine behaviour and acclimatisation to feed method would be of interest. A longer study period may show a further increase in feeding time and a further reduction in stable frustration and HRV level. This would establish whether the use of a slow feeder and thus prolonging eating time could improve the behaviour of hyper reactive horses in the stable, and provide a longer term solution to improving the environment of these animals. It would also reveal whether increases in HRV (LF/ HF) during feeding were related to the individual, the environment as a whole, restricted access to forage or novelty of the method, distinguishing the cause of the increase in stress would allow modification to further improve the welfare of the horse.

4.0 General Discussion

The bites per minute parameter was affected by feed method in both normal and hyper reactive horses. Increased bite rate was recorded when hay was presented in a slow feeder and hay net compared to loose on the floor. Furthermore, intake time increased when horses fed hay from the slow feeder with easy regulator in both trials. However, intake time was not increased significantly in trial one when comparing feeding time between the SF and hay net, therefore the regulator was adapted and the hole size reduced, for use in trial 2. This adapted grid known as the standard regulator successfully increased intake time compared to all other methods ($P < 0.05$). It was also concluded that horses acclimatise to novel feeding devices within 14 days, with intake times seen to reduce between 10.1 and 14.5 mins, this supports the work of Ellis *et al.*, (2015) who found that horses require 5 days acclimatisation to novel feed method before reaching optimum efficiency at removing hay.

Behavioural data (BIR, SBR, HR and HRV) from the study indicated that reducing access to forage by using a SF did not induce any additional stress to the horse. Behavioural initiation rates in normal horses were low (mean 6 BIR/30 mins) compared to hyper reactive horses (mean 13 BIR/30mins), indicating these animals were more settled in their environment and less affected by change in feed method. Spontaneous blink rates were not altered significantly between baseline levels or between treatments in either sample group, this was a positive result as increase in this parameter would have been an indicator of stress.

There was a lot of variability in the HR data of the hyper reactive horses. Some of the variability can be linked to the nature of these horses, as it is likely that their hyper sensitive flight response increased the likelihood of HR being influenced by the

environment. HRV was used as a reliable tool to assess stress level of the horse, in the absence of any physical changes in heart rate or to establish the cause of an elevation in HR (Von Borell *et al.*, 2007). Basal values of HRV showed large inter-individual variance across horses, similar findings in other studies have not concluded the exact origin of this but it is thought to be due to factors including genotype, behaviour and nutritional status (Von Borell *et al.*, 2007).

The sympathetic branches of the ANS were activated during initial feeding in some horses, when hay was presented in a SF and hay net, this was shown by an increase in the LF component of the HRV data, and the vagal tone was reduced as expressed in a decrease of the HF component. Consequently the sympatho-vagal balance (LF/HF) when elevated, reflected the alteration of the ANS from rest to a more stressed state (Reitmann *et al.*, 2004). However, after this initial 'stress period' of acclimatisation the slow feeder worked well and the horses learnt to accept it. Behavioural initiation rate reduced in all horses after day 7 and abhorrent behaviours were no longer seen when horses had access to the slow feeder. Addition of a slow feeder was the only change in routine for these horses and so the positive changes seen in stable behaviour can be attributed to the longer feeding time associated with this method.

Findings from the current study support the work by Hallam *et al.*, (2012) who found that a novel slow feeding system had a positive effect on stress parameters, with a reduction in HR and foraging in bedding recorded when presenting hay in a SF compared to traditional methods. The study by Hallam *et al.*, (2012) also revealed an increase in intake time when comparing traditional methods (22mins/kg) with a SF (50-65mins/kg). Intake time for loose hay in this work was 24.1 mins/kg and from the SF 38.8mins/kg showing similar increases in eating time as Hallam *et al.*, (2012) with

further evidence that restricting access to forage using a SF does not cause additional stress to the animal.

Only three horses were used in the control group and four in the hyper reactive group which provides only a snap shot of the equine population. In experiment one, there was large variability between horses, which resulted in a weak mean, due to the sample size it was not possible to reject outliers and this may have contributed to the lack of significant data found in this study. Further research with a larger sample group and over a longer period is necessary in both groups of horses to establish the long term effect slow feeders have on intake time and behaviour. HRV provided a vital tool for measuring psychological stress and behaviour in relation to feeding and is an avenue for future work.

Overall offering hay in a slow feeder provided horses with longer feeding times and thus a reduction in abhorrent behaviours.

Chapter 5

5.1 Conclusion

Results from this study showed that presenting hay to stabled horses in a slow feeder increased eating time and bite rate significantly when compared to feeding from a hay net or loose from the floor. While all horses showed initial reluctance to feed from the slow feeder they quickly acclimatised, and after approx. 7 days had worked out how to access the hay most efficiently and interacted positively with this novel feeding method. Furthermore the extended eating time and interaction with the slow feeder reduced stress in hyper reactive horses and over the 14 day period there was a notable reduction in negative behaviour. Initially the SF worked very effectively at increasing feeding time compared to other methods, however over the 14 days it became less effective as they learnt to feed from it more efficiently. Nevertheless, the SF successfully increased feeding time by 1.6 times compared to loose hay.

Additional research on the long term use of the slow feeder particularly in young horses that are hyper reactive, may help to establish whether prolonging eating time in the stable environment can help reduce the onset of stereotypy and thus be a tool to improve horse welfare.

Chapter 6

6.1 Bibliography

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Appendix 1: Raw Heart Rate Data

1.1 Baseline Heart Rate and Heart Rate Variability Data Experiment 1 Normal Horses

Horse	Variable - Time Domain			Frequency Domain - LF/HF
	Min HR	Max HR	Mean HR	FFT
BALOU	36.0	56.0	42.6	3.5
	35.0	52.0	40.2	3.2
	32.0	44.0	36.1	2.1
MEAN	34.3	50.7	39.6	2.9
CHANCE	25.0	32.0	27.1	5.5
	20.0	30.0	22.5	5.8
	19.0	129.0	68.6	3.37
MEAN	21.3	63.7	39.4	4.9
ABDULLAH	29.0	48.0	35.2	0.8
	29.0	113.0	40.7	1.3
	33.0	76.0	46.6	1.6
MEAN	30.3	79.0	40.8	1.2

1.2 Baseline Heart Rate and Heart Rate Variability Data Experiment 2 Hyper reactive horses

HORSE	Min HR	Max HR	Mean HR	FFT (LF/HF)
CAMERON	30	49	36.15	2.66
	27	55	42.93	2.62
	29	51	53.18	3.57
Mean	28.67	51.67	44.09	2.95
HELGA	24	96	72	6.84
	27	49	33	3.03
	28	114	40.28	4.36
Mean	26.33	86.33	48.43	4.74
RUPERT	23	117	49.75	2.23
	23	50	39.04	7.44
	26	133	55	5.99
Mean	24	100.0	47.93	5.22
PEPSI	34	49	40.4	2.43
	28	117	45.31	3.45
	28	87	39.9	3.06
Mean	30	84.3	41.87	2.98

1.3 Experiment 1 Heart Rate and Heart Rate Variability Raw Data Normal Horses

Horse	Feed Treatment	Day	Variable			
BALOU			TIME DOMAIN			FREQUENCY DOMAIN-LF/HF
			Min HR	Max HR	Mean HR	FFT
	LOOSE HAY	2	32	42	35.2	2.27
		10	36	61	40.25	1.21
		21	37	52	41.06	1.73
	MEAN		35	51.7	38.8	1.74
	HAYNET	2	41	50	43.6	2.16
		10	32	78	40.7	1.8
		21	40	52	43.8	2.15
	MEAN		37.7	60	42.7	2.04
	SLOW FEEDER	2	38	49	40.7	1.1
		10	36	81	64.5	1.94
		21	37	93	43.07	1.27
	MEAN		37	74.3	49.42	1.44
CHANCE	SLOW FEEDER	2	18	36	30.29	2.41
		10	26	90	41.23	0.69
		21	23	120	46.5	6.47
	MEAN		22.3	82	39.34	3.19
	LOOSE HAY	2	28	67	34.7	4.4
		10	26	67	31.3	5.2
		21	31	46	33.56	1.72
	MEAN		28.3	60	31	3.8
	HAYNET	2	24	46	31.3	2.44
		10	32	57	36.8	1.35
		21	32	57	35.93	1.54
	MEAN		29.3	53.3	34.7	1.78
ABDULLAH	HAYNET	2	32	73	37.9	1.2
		10	25	57	39.32	0.93
		21	24	68	47.17	1.6
	MEAN		27	66	41.46	1.24
	SLOW FEEDER	2	34	53	39.5	0.96
		10	34	60	40.7	0.95
		21	33	52	36.7	1.68
	MEAN		33.6	55	39.0	1.20
	LOOSE HAY	2	35	53	38.92	1.77
		10	39	57	48.6	0.63
		21	34	54	39.5	1.27
	MEAN		36	54.66667	42.34	1.22

1.4 Experiment 2 Heart Rate and Heart Rate Variability Raw Data Hyper Reactive Horses

HORSE	Treatment	DAY	Min HR	Max HR	Mean HR	FFT
CAMERON	LOOSE HAY	1	33	55	37.59	1.07
		7	31	43	34.6	0.84
		14	30	118	54.65	3.87
	MEAN		31.3	72	42.28	1.93
	HAYNET	1	29	54	38.8	2.79
		7	19	85	41.36	2.88
		14	35	120	58.6	2.43
	MEAN		27.67	86.33	46.25	2.70
	GREEDY	1	30	127	52.18	3.67
		7	18	65	29.89	1.99
		14	32	163	75.8	1.77
	MEAN		26.7	118.3	52.62	2.48
	NORMAL	1	31	80	38.36	1.78
		7	21	114	36.3	2.65
		14	28	111	55.51	7.76
	MEAN		26.67	101.7	43.39	4.06
HELGA	LOOSE HAY	1	23	61	40.3	3.47
		7	33	107	40.32	3.69
		14	33	54	37.61	2.84
	MEAN		29.67	74.0	39.4	3.33
	HAYNET	1	33	53	36.95	2.32
		7	33	120	45.93	2.55
		14	28	53	41.92	3.39
	MEAN		31.3	75.33	41.6	2.75
	NORMAL	1	28	67	36.93	3.27
		7	28	111	38.33	4.71
		14	25	122	60.37	4.71
	MEAN		27	100.0	45.21	4.23
	GREEDY	1	28	221	73.33	4.01
		7	34	54	39.31	2.38
		14	27	166	48.07	6.1
	MEAN		29.66667	147.0	53.57	4.16
RUPERT	LOOSE HAY	1	23	60	42.15	8.58
		7	33	72	37.7	7.58
		14	32	67	42.26	2.08
	MEAN		29.33333	66.3	40.7	6.08
	GREEDY	1	18	100	63.19	4.56
		7	26	135	98.97	6.13
		14	15	46	5.58	7.29
	MEAN		19.7	93.7	55.91	5.99
	HAYNET	1	27	116	67.05	5.24
		7	29	101	57.68	5.42
		14	28	72	38.75	3.47
	MEAN		28	96.3	54.49	4.71
	NORMAL	1	25	99	67.6	6.67
		7	29	93	35.71	22.23
		14	31	149	99.46	4.56
	MEAN		28.3	113.7	67.59	11.15

PEPSI	LOOSE HAY	1	32	134	49.97	1.45
		7	39	81	44.57	3.51
		14	32	92	40.47	2.13
	MEAN		34.33	102.3	45.0	2.36
	NORMAL	1	37	51	42.65	2.14
		7	30	54	37.69	3.21
		14	30	78	51.13	3.97
	MEAN		32.3	61.0	43.8	3.11
	GREEDY	1	26	85	40.51	6.03
		7	16	82	41.96	2.44
		14	21	144	58.71	5.26
	MEAN		21	103.7	47.06	4.58
	HAYNET	1	32	56	35.95	3.1
		7	34	138	84.79	7.78
		14	32	52	37.49	2.68
	MEAN		32.66667	82.0	52.74	4.52

Appendix 2 Spontaneous Eye Blink Rate Data

2.1 Baseline Spontaneous Blink Rate Data Experiment 1

BLINK RATE

Horse	BASELINE DATA			MEAN
	1	2	3	
Balou	278	227	258	254.3
Chance	434	370	446	416.7
Abdullah	327	361	258	315.3

2.2 Baseline Spontaneous Blink Rate Data Experiment 2

HORSE	Blink Rate	Mean
CAMERON	529	509
	481	
	518	
HELGA	601	615
	634	
	611	
RUPERT	618	639
	628	
	671	
PEPSI	642	607
	567	
	612	

2.3 Spontaneous Eye Blink Rates Experiment 1

Horse	Feed Treatment	Day	Blink Rate	Mean
Balou	Loose Hay	2	184	185
		10	183	
		21	187	
	Hay net	2	142	175.3
		10	218	
		21	166	
	Slow Feeder	2	144	176.7
		10	167	
		21	219	

Horse	Feed Treatment	Day	Blink Rate	Mean
Chance	slow feeder	2	372	341
		10	348	
		21	302	
	Loose hay	2	312	336
		10	419	

		21	276	
	Hay net	2	284	287
		10	262	
		21	314	

Horse	Feed Treatment	Day	Blink Rate	Mean
Abdullah	Hay net	2	231	189
		10	162	
		21	174	
	Slow Feeder	2	252	180.7
		10	136	
		21	154	
	Loose hay	2	234	168
		10	148	
		21	122	

2.4 Spontaneous Eye Blink Rates Experiment 2

Horse	Feed Treatment	Day	Blink Rate	Mean
Cameron	Hay net	2	390	391
		8	387	
		13	396	
	Loose Hay	2	402	393
		8	385	
		13	391	
	standard	2	456	443
		8	462	
		13	412	
	NORMAL	2	446	469
		8	451	
		13	511	

Horse	Feed Treatment	Day	Blink Rate	Mean
HELGA	Loose Hay	2	616	605
		8	579	
		13	621	
	Hay net	2	552	568
		8	581	
		13	571	
	Normal	2	629	597.33
		8	545	
		13	618	
	standard	2	647	588.00

		8	503	
		13	614	

Horse	Feed Treatment	Day	Blink Rate	Mean
RUPERT	Loose Hay	2	631	632
		8	624	
		13	642	
	standard	2	698	682
		8	687	
		13	661	
	Hay net	2	618	602
		8	602	
		13	586	
	NORMAL	2	592	624
		8	669	
		13	611	

Horse	Feed Treatment	Day	Blink Rate	Mean
PEPSI	Loose Hay	2	608	594
		8	562	
		13	612	
	normal	2	622	649.3
		8	654	
		13	672	
	GREEDY	2	626	600.7
		8	596	
		13	580	
	Hay net	2	584	611.3
		8	631	
		13	619	

Appendix 3 Behavioural Initiation Rate

3.1 Total BIR score for Normal Horses Experiment 1

HORSE	DAY	Loose Hay	Hay net	Slow Feeder
ABDULLAH	2	5	6	7
	11	3	13	6
	21	5	5	5
	MEAN	4.3	8.0	6.0
CHANCE	2	6	7	5
	11	8	3	9
	21	7	2	7
	MEAN	7	4	7
BALOU	2	5	5	5
	11	5	2	6
	21	7	4	4
	MEAN	5.7	3.7	5.0

3.2 Total BIR score for Hyper Reactive Horses Experiment 2

HORSE	DAY	Loose hay	Hay net	Standard grid	normal grid
CAMERON	2	8	11	7	11
	8	7	17	12	9
	13	20	11	7	17
	MEAN	11.7	13.0	8.7	12.3
HELGA	2	3	4	5	5
	8	5	5	4	4
	13	11	10	7	4
	MEAN	6.3	6.33	5.3	4.33
RUPERT	2	6	9	25	6
	8	7	17	10	7
	13	7	16	12	8
	MEAN	6.7	14.0	15.67	7.00
PEPSI	2	3	6	11	5
	8	5	20	12	15
	13	3	11	7	19
	MEAN	3.7	12.3	10	13.0

3.3 Ethogram used adapted from Young *et al.*, (2012)

Behaviour	Behavioural Description
Rolling	Drop to knees, roll onto side then back and perhaps all the way over then return to feet
Lying	Lying with sternum in contact with ground surface, legs folded under the body or stretched out on side with legs stretched out
Standing resting	Stood resting a hind limb
Standing alert	Standing, ears pricked forward
Looking out the window	Standing with head out of the stable window
Looking over the stable door	Head over the stable door
Walking	Moving around the stable
Scratching	Rubbing any part of the body against part of the stable or using hind foot or teeth to scratch part of own body
Pawing	Striking a vertical or horizontal surface or the air with forelimb
Kicking	Any limb thrust forwards, backwards or to the side, contact with part of the stable may be achieved
Interaction with slow feeder	Pushing feeder, leaning on, sniffing, licking.
Stretch	Rigid extension of the limbs and arching of the neck and back
Tail Swish	Tail is flicked to one side and/or the other of the quarters
Defecation/Urination	Elimination of faeces and urine
Eating	Chewing and ingesting food
Drinking	Intake of water
Exploratory	Lick, sniff or touch with muzzle or tongue parts of the stable or floor
Self -Care	Non-ingestive behaviours involving the muzzle and teeth including grooming and swatting flies on body.
Repetitive Oral	A repeated, relatively invariant sequence of movements with no obvious function. Including cribbing, wood chewing, windsucking
Repetitive Locomotory	Lateral movement of the head, neck and shoulders from side to side in a rhythmic repetitive manner – Weaving Repetitive movement in a circular motion – Box walking

3.4 Summary of Behaviours Observed from CCTV during 30 mins feeding

(COLOURED SCORES INDICATE BEHAVIOUR WAS OBSERVED)

BEHAVIOUR	CAMERON	PEPSI	RUPERT	HELGA	ABDULLAH	BALOU	CHANCE
Rolling							
Lying							
Standing resting							
Standing alert							
Looking out the window							
Looking over the stable door							
Walking							
Scratching							
Pawing							
Kicking							
interact with feeder							
Stretch							
Tail Swish							
Defecation							
Urination							
Eating							
Drinking							
Exploratory							
Self Care							
Repetitive Oral							
Repetitive Locomotory							

Appendix 4 – Raw Intake Data

4.1 Experiment 1 Intake Data Normal Horses

Horse - BALOU	Day	Hay (kg)	Hay (g)	Intake Time (mins)	g/min	mins/kg	NOTES
Loose Hay	1	2	2000	61.02	33	31	23g left in bedding
	11	2	2000	65.05	31	33	37g in bedding
	20	2	2000	67	30	34	10g left in bedding
	Average			64	31	32	
	Standard Deviation					1.2	
Hay net	1	2	2000	59.12	34	30	165g in bed
	11	2	2000	81.24	25	41	153g in bed
	20	2	2000	49.33	41	25	325g left in bed
	Average			63.23	33	32	
	Standard Deviation					6.7	
Slow Feeder	1	2	2000	81.54	25	41	
	11	2	2000	67.14	30	34	
	20	2	2000	61.38	33	31	
	Average			70.02	29	35	
	Standard Deviation						4.2

Horse	Day	Hay (kg)	Hay (g)	Intake Time (mins)	g/min	mins/kg	NOTES
CHANCE	1	2	2000	75.15	27	38	No hay left
Slow Feeder	11	2	2000	73.29	27	37	
	20	2	2000	68.21	29	34	
	Average			72.2	28	36	
	Standard Deviation					1.5	
Loose hay	1	2	2000	55.23	36	28	48g left
	11	2	2000	56.03	36	28	71g in bed
	20	2	2000	43.12	46	22	24g left
	Average			51.5	39	26	
	Standard Deviation					3.0	

Horse CHANCE	Day	Hay (kg)	Hay (g)	Intake Time (mins)	g/min	mins/kg	NOTES
Hay net	1	2	2000	62.53	32	31	54g left
	11	2	2000	44.55	45	22	22g left
	20	2	2000	35.12	57	18	
	Average			47.4	45	24	

Horse ABDULLAH	Day	Hay (kg)	Hay (g)	Intake Time (mins)	g/min	mins/kg	NOTES
Hay net	1	2	2000	55.26	36	28	175g left in bedding
	11	2	2000	64.21	31	32	135g left in bedding
	20	2	2000	61	33	31	50g left in bedding
	Average			60	33	30	
	Standard Deviation					1.9	
Slow Feeder	1	2	2000	64	31	32	No hay left
	11	2	2000	60.34	33	30	
	20	2	2000	57.09	35	29	
	Average			60.48	33	30	
	Standard Deviation					1.4	
Loose Hay	1	2	2000	56.46	35	28	123g in bed
	11	2	2000	36.03	56	18	98 left
	20	2	2000	37.38	54	19	27g
	Average			43.29	48	22	

4.2 Experiment 2 Intake Data Hyper Reactive Horses

Horse - Cameron	Day	Hay (kg)	Hay (g)	Intake Time (mins)	g/min	mins/kg	NOTES
Hay net	1	2	2000	62.02	32	31	240g left in bed
	11	2	2000	54.21	37	27	415g left
	20	2	2000	34.31	58	17	52g
	Average			50.18	42	25	
	Standard Deviation					5.8	

GREEDY GRID	1	2	2000	95.26	21	48	No Hay left
	11	2	2000	94.05	21	47	
	20	2	2000	90.47	22	45	
	Average			93.26	21	47	
	Standard Deviation					1.0	
NORMAL GRID	1	2	2000	88.25	23	44	No hay left
	11	2	2000	45.03	44	23	
	20	2	2000	61.27	33	31	
	Average			64.85	33	32	
	Standard Deviation					8.9	
LOOSE HAY	1	2	2000	51.57	39	26	37g left
	11	2	2000	43.56	46	22	92g
	20	2	2000	33.53	60	17	815g left
	Average			42.89	48	21	
	Standard Deviation					3.7	

Horse - HELGA	Day	Hay (kg)	Hay (g)	Intake Time (mins)	g/min	mins/kg	NOTES
LOOSE HAY	1	2	2000	35.07	57	18	52g
	7	2	2000	44.04	45	22	102g
	14	2	2000	42.56	47	21	156g
	Average			40.56	50	20	
	Standard Deviation					2.0	
Hay net	1	2	2000	79.58	31	33	92g
	7	2	2000	65.09	49	21	176 left
	14	2	2000	41.11	38	27	201 left
	Average			53.10	39	27	
	Standard Deviation					4.9	
NORMAL GRID	1	2	2000	78.28	26	39	No hay left
	7	2	2000	76.46	26	38	
	14	2	2000	47.55	42	24	
	Average			67.43	31	34	

	Standard Deviation					7.0	
--	-----------------------	--	--	--	--	-----	--

GREEDY GRID	1	2	2000	95.57	21	48	No hay left
	7	2	2000	76.16	26	38	
	14	2	2000	81.31	25	41	
	Average			84.35	24	42	
	Standard Deviation					4.1	

Horse - RUPERT	Day	Hay (kg)	Hay (g)	Intake Time (mins)	g/min	mins/kg	NOTES
LOOSE HAY	1	2	2000	40.25	50	20	22g
	7	2	2000	42.59	47	21	64g
	14	2	2000	44.15	45	22	98g
	Average			42.33	47	21	
	Standard Deviation					0.8	
GREEDY GRID	1	2	2000	96.01	21	48	No hay left
	7	2	2000	94.39	21	47	
	14	2	2000	90.33	22	45	
	Average			93.58	21	47	
	Standard Deviation					1.2	
HAYNET	1	2	2000	59.37	34	30	285 left
	7	2	2000	52.37	38	26	127g
	14	2	2000	47.55	42	24	236g
	Average			53.10	38	27	
	Standard Deviation					2.4	
NORMAL GRID	1	2	2000	54.39	37	27	no Hay left
	7	2	2000	44.12	45	22	
	14	2	2000	56.43	35	28	
	Average			51.65	39	26	
	Standard Deviation					2.7	

Horse PEPSI	Day	Hay (kg)	Hay (g)	Intake Time (mins)	g/min	mins/kg
LOOSE HAY	1	2	2000	44.33	45	22
	7	2	2000	52.35	38	26
	14	2	2000	48.22	41	24
	Average			48.3	42	24
	Standard Deviation					1.6

Horse PEPSI	Day	Hay (kg)	Hay (g)	Intake Time (mins)	g/min	mins/kg
NORMAL GRID	1	2	2000	91.04	22	46
	7	2	2000	72.11	28	36
	14	2	2000	52.26	38	26
	Average			71.80	29	36
	Standard Deviation					7.9
GREEDY GRID	1	2	2000	86.31	23	43
	7	2	2000	80.4	25	40
	14	2	2000	72.55	28	36
	Average			79.75	25	40
	Standard Deviation					2.8
HAYNET	1	2	2000	61.45	40	25
	7	2	2000	49.56	52	19
	14	2	2000	38.47	45	22
	Average			44.0	46	22
	Standard Deviation					2.3

Appendix 5: Chews per minute and Bites per minute Raw Data

5.1 Experiment 1 Normal Horses Chews per Minute

Horse	Day HAYNET		
ABDULLAH	1	11	20
Chews/min	80	62	56
Chews/min	60	61	62
Chews/min	54	65	54
Mean	64.7	62.7	57.3

Horse	Day SLOW FEEDER		
ABDULLAH	1	11	20
Chews/min	72	60	71
Chews/min	60	71	69
Chews/min	61	62	72
Mean	64.3	64.3	70.7

Horse	Day LOOSE HAY		
ABDULLAH	1	11	20
Chews/min	63	98	102
Chews/min	66	81	91
Chews/min	61	83	89
Mean	63.3	87.3	94

Horse	Slow Feeder		
CHANCE	1	11	20
Chews/min	81	69	84
Chews/min	86	74	82
Chews/min	79	70	97
Mean	82	71	87.7

Horse	LOOSE HAY		
CHANCE	1	11	20
Chews/min	50	77	82
Chews/min	43	79	81
Chews/min	72	91	93
Mean	55	82.3	85.3

Horse	HAYNET		
CHANCE	1	11	20
Chews/min	97	83	96
Chews/min	62	92	101
Chews/min	85	89	90
Mean	81.3	88	95.7
Chews/min	62	92	101
Chews/min	85	89	90
Mean	76.1	89.666667	95.6

Horse	Day - LOOSE HAY		
BALOU	1	11	20
Chews/min	80	81	85
Chews/min	75	84	99
Chews/min	65	79	94
Mean	73.3	81.3	92.7

Horse	Day - HAYNET		
BALOU	1	11	20
Chews/min	77	71	68
Chews/min	53	87	72
Chews/min	60	82	92
Mean	63	80	77

Horse	Day - SF		
BALOU	1	11	20
Chews/min	60	84	89
Chews/min	73	80	99
Chews/min	62	96	90
Mean	65	86.7	92.7

5.2 Bites per minute Normal Horses Experiment 1

Horse	HAYNET		
ABDULLAH	1	11	20
bites/min	9	8	5
bites/min	8	7	8
bites/min	7	7	9
Mean	8	7.3	7.3

Horse	Slow feeder		
ABDULLAH	1	11	20
bites/min	9	6	11
bites/min	7	8	8
bites/min	8	11	4
Mean	8	8.3	7.7

Horse	LOOSE HAY		
ABDULLAH	1	11	20
bites/min	2	5	6
bites/min	5	8	5
bites/min	4	6	7
Mean	3.7	6.3	6

Horse	Slow Feeder		
CHANCE	1	11	20
bites/min	18	15	9
bites/min	12	11	8
bites/min	9	14	7
Mean	13	13.3	8

Horse	LOOSE HAY		
CHANCE	1	11	20
bites/min	5	9	6
bites/min	6	12	7
bites/min	4	14	8
Mean	5	11.7	7

Horse	HAYNET		
CHANCE	1	11	20
bites/min	10	14	12
bites/min	7	16	10
bites/min	11	15	8
Mean	9.3	15	10
bites/min	7	16	10
bites/min	11	15	8
Mean	9.1	15.3	9.3

Horse	Day LOOSE HAY		
BALOU	1	11	20
bites/min	9	6	9
bites/min	8	4	7
bites/min	12	8	6
Mean	9.7	6	7.3

Horse	Day HAYNET		
BALOU	1	11	20
bites/min	15	13	12
bites/min	14	14	10
bites/min	11	16	11
Mean	13	14	11

Horse	Day SF		
BALOU	1	11	20
bites/min	12	9	16
bites/min	9	10	11
bites/min	15	17	13
Mean	12	12	13.3

5.3 Chews per minute Experiment 2 Hyper Reactive Horses

Horse	Day LOOSE HAY		
Cameron	1	11	20
Chews/min	84	87	62
Chews/min	89	82	53
Chews/min	82	76	55
Mean	85.0	81.7	56.7

Horse	Day HAYNET		
Cameron	1	11	20
Chews/min	54	70	78
Chews/min	59	65	80
Chews/min	67	61	86
Mean	60.0	65.3	81.3

Horse	Standard SF		
Cameron	1	11	20
Chews/min	75	77	71
Chews/min	62	59	63
Chews/min	68	74	76
Mean	68.3	70.0	70.0
Mean	66.1	67.7	69.7

Horse	Normal SF		
Cameron	1	11	20
Chews/min	57	70	67
Chews/min	72	67	84
Chews/min	61	79	82
Mean	63.3	72.0	77.7

Horse	Day LOOSE HAY		
HELGA	1	7	14
Chews/min	63	66	64
Chews/min	79	77	73
Chews/min	67	77	79
Mean	69.7	73.3	72.0

Horse	Day HAYNET		
HELGA	1	7	14
Chews/min	84	81	68
Chews/min	78	65	71
Chews/min	64	87	81
Mean	75.3	77.7	73.3

Horse	NORMAL SF		
HELGA	1	7	14
Chews/min	65	76	69
Chews/min	90	88	84
Chews/min	8	95	90
Mean	54.3	86.3	81.0

Horse	Standard SF		
HELGA	1	7	14
Chews/min	92	75	96
Chews/min	81	75	72
Chews/min	75	82	79
Mean	82.7	77.3	82.3

Horse	Day LOOSE HAY		
RUPERT	1	7	14
Chews/min	79	75	66
Chews/min	90	75	78
Chews/min	78	80	82
Mean	82.3	76.7	75.3

Horse	Standard SF		
RUPERT	1	7	14
Chews/min	66	72	78
Chews/min	54	67	50
Chews/min	58	72	78
Mean	59.3	70.3	68.7

Horse	HAYNET		
RUPERT	1	7	14
Chews/min	64	84	82
Chews/min	65	72	79
Chews/min	68	83	86
Mean	65.7	79.7	82.3

Horse	NORMAL SF		
RUPERT	1	7	14
Chews/min	78	82	88
Chews/min	81	79	84
Chews/min	68	81	85
Mean	75.7	80.7	85.7

Horse	LOOSE HAY		
PEPSI	1	7	14
Chews/min	89	87	85
Chews/min	81	80	89
Chews/min	87	81	92
Mean	85.7	82.7	88.7

Horse	NORMAL SF		
PEPSI	1	7	14
Chews/min	86	81	89
Chews/min	80	87	89
Chews/min	71	75	82
Mean	79.0	81.0	86.7

Horse	STANDARD SF		
PEPSI	1	7	14
Chews/min	90	88	99
Chews/min	86	97	89
Chews/min	85	91	87
Mean	87.0	92.0	91.7

Horse	HAYNET		
PEPSI	1	7	14
Chews/min	86	77	88
Chews/min	88	85	93
Chews/min	86	89	83
Mean	86.7	83.7	88.0

5.4 Bites per minute Experiment 2 Hyper Reactive Horses

Horse	LOOSE HAY		
Cameron	1	11	20
Bites/min	8	11	7
Bites/min	6	8	5
Bites/min	10	6	8
Mean	8.0	8.3	6.7

Horse	HAYNET		
Cameron	1	11	20
Bites/min	10	13	10
Bites/min	11	10	6
Bites/min	9	10	7
Mean	10.0	11.0	7.7

Horse	STANDARD SF		
Cameron	1	11	20
Bites/min	16	13	11
Bites/min	9	12	14
Bites/min	13	15	18
Mean	12.7	13.3	14.3

Horse	NORMAL SF		
Cameron	1	11	20
Bites/min	10	8	11
Bites/min	10	13	12
Bites/min	9	10	12
Mean	9.7	10.3	11.7
Mean	9.6	11.1	11.9

Horse	LOOSE HAY		
HELGA	1	7	14
Bites/min	9	7	6
Bites/min	9	8	10
Bites/min	7	8	10
Mean	8.3	7.7	8.7

Horse	Day HAYNET		
HELGA	1	7	14
Bites/min	16	14	15
Bites/min	13	12	10
Bites/min	11	12	13
Mean	13.3	12.7	12.7

Horse	NORMAL sf		
HELGA	1	7	14
Bites/min	15	20	17
Bites/min	7	9	11
Bites/min	11	10	9
Mean	11.0	13.0	12.3

Horse	STANDARD SF		
HELGA	1	7	14
Bites/min	15	13	10
Bites/min	20	24	22
Bites/min	12	10	17
Mean	15.7	15.7	16.3

Horse	Day LOOSE HAY		
RUPERT	1	7	14
Bites/min	6	10	9
Bites/min	10	9	11
Bites/min	9	6	8
Mean	8.3	8.3	9.3

Horse	STANDARD SF		
RUPERT	1	7	14
Bites/min	11	12	16
Bites/min	8	10	13
Bites/min	13	14	15
Mean	10.7	12.0	14.7

Horse	HAYNET		
RUPERT	1	7	14
Bites/min	14	12	9
Bites/min	18	13	19
Bites/min	14	12	15
Mean	15.3	12.3	14.3

Horse	NORMAL SF		
RUPERT	1	7	14
Bites/min	14	17	18
Bites/min	20	16	19
Bites/min	18	16	17
Mean	17.3	16.3	18.0

Horse	Day LOOSE HAY		
PEPSI	1	7	14
Bites/min	7	8	7
Bites/min	10	8	12
Bites/min	6	8	10
Mean	7.7	8.0	9.7

Horse	NORMAL SF		
PEPSI	1	7	14
Bites/min	11	16	22
Bites/min	20	16	18
Bites/min	9	11	13
Mean	13.3	14.3	17.7

Horse	STANDARD SF		
PEPSI	1	7	14
Bites/min	14	21	18
Bites/min	14	16	20
Bites/min	13	11	16
Mean	13.7	16.0	18.0

Horse	Day HAYNET		
PEPSI	1	7	14
Bites/min	15	16	19
Bites/min	16	18	17
Bites/min	16	18	13
Mean	15.7	17.3	16.3

Appendix 6 : Genstat Reports

6.1 Analysis of Variance Experiment 1

GenStat Release 15.1 (PC/Windows 7) 30 November 2016 10:30:37

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GenStat Fifteenth Edition
GenStat Procedure Library Release PL23.1

```
1 SET [WORKINGDIRECTORY='//filestore/staff/mmcolyer']
2 "Data taken from unsaved spreadsheet: New Data;1"
3 DELETE [REDEFINE=yes] _stitle_: TEXT _stitle_
4 READ [PRINT=*; SETNVALUES=yes] _stitle_
7 PRINT [IPRINT=*] _stitle_; JUST=left
```

Data imported from Clipboard
on: 30-Nov-2016 10:30:53

```
8 DELETE [REDEFINE=yes] horse,Treatment,Intake_Time_mins,g_min,mins_kg,\
9 Chews_Min,Bites_Min
10 UNITS [NVALUES=*]
11 FACTOR [MODIFY=no; NVALUES=9; LEVELS=3; REFERENCE=1] horse
12 READ horse; FREPRESENTATION=ordinal
```

Identifier	Values	Missing	Levels
horse	9	0	3

```
14 FACTOR [MODIFY=no; NVALUES=9; LEVELS=3; LABELS=lt('H','L','S')\
15 ; REFERENCE=1] Treatment
16 READ Treatment; FREPRESENTATION=ordinal
```

Identifier	Values	Missing	Levels
Treatment	9	0	3

```
18 VARIATE [NVALUES=9] Intake_Time_mins
19 READ Intake_Time_mins
```

Identifier	Minimum	Mean	Maximum	Values	Missing
Intake_Time_mins	43.29	59.12	72.20	9	0

```
21 VARIATE [NVALUES=9] g_min
22 READ g_min
```

Identifier	Minimum	Mean	Maximum	Values	Missing
g_min	28.00	35.44	48.00	9	0

```
24 VARIATE [NVALUES=9] mins_kg
25 READ mins_kg
```

Identifier	Minimum	Mean	Maximum	Values	Missing
mins_kg	22.00	29.67	36.00	9	0

```
27 VARIATE [NVALUES=9] Chews_Min
28 READ Chews_Min
```

Identifier	Minimum	Mean	Maximum	Values	Missing
Chews_Min	61.60	76.01	88.30	9	0

30 VARIATE [NVALUES=9] Bites_Min
31 READ Bites_Min

Identifier	Minimum	Mean	Maximum	Values	Missing
Bites_Min	5.300	9.022	13.00	9	0

33
34 "General Analysis of Variance"
35 BLOCK horse
36 TREATMENTS Treatment
37 COVARIATE "No Covariate"
38 ANOVA [PRINT=aovtable,information,means; FACT=32; CONTRASTS=7; PCONTRASTS=7;
FPROB=yes;\n
39 PSE=diff,lsd; LSDLEVEL=5] Bites_Min

Analysis of variance

Variate: Bites_Min

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
horse stratum	2	24.816	12.408	6.23	
horse.*Units* stratum					
Treatment	2	21.296	10.648	5.35	0.074
Residual	4	7.964	1.991		
Total	8	54.076			

Tables of means

Variate: Bites_Min

Grand mean 9.02

Treatment	H	L	S
	10.67	6.97	9.43

Standard errors of differences of means

Table	Treatment
rep.	3
d.f.	4
s.e.d.	1.152

Least significant differences of means (5% level)

Table	Treatment
rep.	3

d.f. 4
l.s.d. 3.199

```
40 DELETE [REDEFINE=yes] _mean, _rep, _var, _resid, _rdf, _scode
41 AKEEP [FACTORIAL=9] Treatment; MEAN=_mean; REP=_rep; VARIANCE=_var; RTERM=_resid;\
42 STATUS=_scode
43 IF _scode.IN.!(1,2)
44 AKEEP [FACTORIAL=9] #_resid; DF=_rdf
45 AMCOMPARISON [PRINT=letter; METHOD=fulsd; DIRECTION=ascending; PROB=0.05] Treatment
```

Fisher's unprotected least significant difference test

Treatment

	Mean	
L	6.967	a
S	9.433	ab
H	10.667	b

```
46 ELSE
47 PRINT !t('Multiple comparisons available only if all components of the term',\
48 'are estimated with equal efficiency and in the same stratum.');"
49 JUST=left
50 ENDIF
51 "General Analysis of Variance"
52 BLOCK horse
53 TREATMENTS Treatment
54 COVARIATE "No Covariate"
55 ANOVA [PRINT=aovtable,information,means; FACT=32; CONTRASTS=7; PCONTRASTS=7;
FPROB=yes;\
56 PSE=diff,lsd; LSDLEVEL=5] Chews_Min
```

Analysis of variance

Variate: Chews_Min

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
horse stratum	2	170.10	85.05	1.00	
horse.*Units* stratum					
Treatment	2	52.28	26.14	0.31	0.751
Residual	4	340.39	85.10		
Total	8	562.77			

Tables of means

Variate: Chews_Min

Grand mean 76.0

Treatment	H	L	S
-----------	---	---	---

74.6 79.4 74.0

Standard errors of differences of means

Table	Treatment
rep.	3
d.f.	4
s.e.d.	7.53

Least significant differences of means (5% level)

Table	Treatment
rep.	3
d.f.	4
l.s.d.	20.91

```

57 DELETE [REDEFINE=yes] _mean, _rep, _var, _resid, _rdf, _scode
58 AKEEP [FACTORIAL=9] Treatment; MEAN=_mean; REP=_rep; VARIANCE=_var; RTERM=_resid;\
59 STATUS=_scode
60 IF _scode.IN.!(1,2)
61 AKEEP [FACTORIAL=9] #_resid; DF=_rdf
62 AMCOMPARISON [PRINT=letter; METHOD=fulsd; DIRECTION=ascending; PROB=0.05] Treatment

```

Fisher's unprotected least significant difference test

Treatment

	Mean	
S	74.00	a
H	74.63	a
L	79.40	a

```

63 ELSE
64 PRINT !t('Multiple comparisons available only if all components of the term',\
65 'are estimated with equal efficiency and in the same stratum.');
```

```

66 JUST=left
67 ENDIF
68 "General Analysis of Variance"
69 BLOCK horse
70 TREATMENTS Treatment
71 COVARIATE "No Covariate"
72 ANOVA [PRINT=aovtable,information,means; FACT=32; CONTRASTS=7; PCONTRASTS=7;
FPROB=yes;\
73 PSE=diff,lsd; LSDLEVEL=5] Intake_Time_mins

```

Analysis of variance

Variate: Intake_Time_mins

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
horse stratum	2	206.50	103.25	1.81	
horse.*Units* stratum					
Treatment	2	344.08	172.04	3.01	0.159
Residual	4	228.66	57.16		
Total	8	779.24			

Tables of means

Variate: Intake_Time_mins

Grand mean 59.1

Treatment	H	L	S
	56.9	52.9	67.6

Standard errors of differences of means

Table	Treatment
rep.	3
d.f.	4
s.e.d.	6.17

Least significant differences of means (5% level)

Table	Treatment
rep.	3
d.f.	4
l.s.d.	17.14

```
74 DELETE [REDEFINE=yes] _mean, _rep, _var, _resid, _rdf, _scode
75 AKEEP [FACTORIAL=9] Treatment; MEAN=_mean; REP=_rep; VARIANCE=_var; RTERM=_resid;\
76 STATUS=_scode
77 IF _scode.IN.!(1,2)
78 AKEEP [FACTORIAL=9] #_resid; DF=_rdf
79 AMCOMPARISON [PRINT=letter; METHOD=fulsd; DIRECTION=ascending; PROB=0.05] Treatment
```

Fisher's unprotected least significant difference test

Treatment

	Mean	
L	52.93	a
H	56.88	a
S	67.57	a

```
80 ELSE
81 PRINT !t('Multiple comparisons available only if all components of the term',\
82 'are estimated with equal efficiency and in the same stratum.');"
83 JUST=left
84 ENDIF
85 "General Analysis of Variance"
86 BLOCK horse
87 TREATMENTS Treatment
88 COVARIATE "No Covariate"
89 ANOVA [PRINT=aovtable,information,means; FACT=32; CONTRASTS=7; PCONTRASTS=7;
FPROB=yes;\
90 PSE=diff,lsd; LSDLEVEL=5] g_min
```

Analysis of variance

Variate: g_min

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
horse stratum	2	89.56	44.78	1.08	
horse.*Units* stratum					
Treatment	2	141.56	70.78	1.71	0.290
Residual	4	165.11	41.28		
Total	8	396.22			

Tables of means

Variate: g_min

Grand mean 35.4

Treatment	H	L	S
	37.0	39.3	30.0

Standard errors of differences of means

Table	Treatment
rep.	3
d.f.	4
s.e.d.	5.25

Least significant differences of means (5% level)

Table	Treatment
rep.	3
d.f.	4
l.s.d.	14.56

```

91 DELETE [REDEFINE=yes] _mean, _rep, _var, _resid, _rdf, _scode
92 AKEEP [FACTORIAL=9] Treatment; MEAN=_mean; REP=_rep; VARIANCE=_var; RTERM=_resid;\
93 STATUS=_scode
94 IF _scode.IN.!(1,2)
95 AKEEP [FACTORIAL=9] #_resid; DF=_rdf
96 AMCOMPARISON [PRINT=letter; METHOD=fulsd; DIRECTION=ascending; PROB=0.05] Treatment

```

Fisher's unprotected least significant difference test

Treatment

	Mean	
S	30.00	a
H	37.00	a
L	39.33	a

```

97 ELSE
98 PRINT !t('Multiple comparisons available only if all components of the term',\
99 'are estimated with equal efficiency and in the same stratum.');"
100 JUST=left
101 ENDIF
102 "General Analysis of Variance"
103 BLOCK horse
104 TREATMENTS Treatment
105 COVARIATE "No Covariate"
106 ANOVA [PRINT=aovtable,information,means; FACT=32; CONTRASTS=7; PCONTRASTS=7;
FPROB=yes;\
107 PSE=diff,lsd; LSDLEVEL=5] mins_kg

```

Analysis of variance

Variate: mins_kg

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
horse stratum	2	52.67	26.33	1.97	
horse.*Units* stratum					
Treatment	2	78.00	39.00	2.92	0.165
Residual	4	53.33	13.33		
Total	8	184.00			

Tables of means

Variate: mins_kg

Grand mean 29.7

Treatment	H	L	S
	28.7	26.7	33.7

Standard errors of differences of means

Table	Treatment
rep.	3
d.f.	4
s.e.d.	2.98

Least significant differences of means (5% level)

Table	Treatment
rep.	3
d.f.	4
l.s.d.	8.28

```
108 DELETE [REDEFINE=yes] _mean, _rep, _var, _resid, _rdf, _scode
109 AKEEP [FACTORIAL=9] Treatment; MEAN=_mean; REP=_rep; VARIANCE=_var; RTERM=_resid;\
110 STATUS=_scode
111 IF _scode.IN.!(1,2)
112 AKEEP [FACTORIAL=9] #_resid; DF=_rdf
113 AMCOMPARISON [PRINT=letter; METHOD=fulsd; DIRECTION=ascending; PROB=0.05] Treatment
```

Fisher's unprotected least significant difference test

Treatment

	Mean	
L	26.67	a
H	28.67	a
S	33.67	a

```
114 ELSE
115 PRINT !t('Multiple comparisons available only if all components of the term',\
116 'are estimated with equal efficiency and in the same stratum.');"
117 JUST=left
118 ENDIF
119 "General Analysis of Variance"
120 BLOCK horse
121 TREATMENTS Treatment
122 COVARIATE "No Covariate"
123 ANOVA [PRINT=aovtable,information,means; FACT=32; CONTRASTS=7; PCONTRASTS=7;
FPROB=yes;\
124 PSE=diff,lsd; LSDLEVEL=5] mins_kg
```

Genstat Eighteenth Edition
 Genstat Procedure Library Release PL26.1

```
1 SET [WORKINGDIRECTORY='//filestore/students/10126268/Documents']
2 "Data taken from unsaved spreadsheet: New Data;1"
3 DELETE [REDEFINE=yes] _stitle_: TEXT _stitle_
4 READ [PRINT=*; SETNVALUES=yes] _stitle_
7 PRINT [IPRINT=*] _stitle_; JUST=left
```

Data imported from Clipboard
 on: 30-Nov-2016 11:41:14

```
8 DELETE [REDEFINE=yes] horse,Treatment,MEAN_HR,MIN,MAX,HRV_If_hf
9 UNITS [NVALUES=9]
10 FACTOR [MODIFY=no; NVALUES=9; LEVELS=3; LABELS=*; REFERENCE=1] horse
11 READ horse; FREPRESENTATION=ordinal
```

Identifier	Values	Missing	Levels
horse	9	0	3

```
13 FACTOR [MODIFY=no; NVALUES=9; LEVELS=3; LABELS=!(('H','L','S'))\
14 ; REFERENCE=1] Treatment
15 READ Treatment; FREPRESENTATION=ordinal
```

Identifier	Values	Missing	Levels
Treatment	9	0	3

```
17 VARIATE [NVALUES=9] MEAN_HR
18 READ MEAN_HR
```

Identifier	Minimum	Mean	Maximum	Values	Missing
MEAN_HR	31.00	39.30	49.40	9	0

```
20 VARIATE [NVALUES=9] MIN
21 READ MIN
```

Identifier	Minimum	Mean	Maximum	Values	Missing
MIN	22.30	31.81	37.70	9	0

```
23 VARIATE [NVALUES=9] MAX
24 READ MAX
```

Identifier	Minimum	Mean	Maximum	Values	Missing
MAX	51.70	61.89	82.00	9	0

```
26 VARIATE [NVALUES=9] HRV_If_hf
27 READ HRV_If_hf
```

Identifier	Minimum	Mean	Maximum	Values	Missing
HRV_If_hf	1.200	1.960	3.770	9	0

```

29
30 "General Analysis of Variance"
31 BLOCK horse
32 TREATMENTS Treatment
33 COVARIATE "No Covariate"
34 ANOVA [PRINT=aovtable,information,means; FACT=32; CONTRASTS=7; PCONTRASTS=7;
FPROB=yes;\
35 PSE=diff,lsc; LSDLEVEL=5] HRV_lf_hf

```

Analysis of variance

Variate: HRV_lf_hf

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
horse stratum	2	4.5528	2.2764	5.19	
horse.*Units* stratum					
Treatment	2	0.4761	0.2380	0.54	0.619
Residual	4	1.7545	0.4386		
Total	8	6.7834			

Tables of means

Variate: HRV_lf_hf

Grand mean 1.96

Treatment	H	L	S
	1.68	2.24	1.96

Standard errors of differences of means

Table	Treatment
rep.	3
d.f.	4
s.e.d.	0.541

Least significant differences of means (5% level)

Table	Treatment
rep.	3
d.f.	4
l.s.d.	1.501

```

36 "General Analysis of Variance"
37 BLOCK horse
38 TREATMENTS Treatment
39 COVARIATE MAXMEAN_HRMIN
Fault 1, code VA 24, statement 1 on line 39

```

Command: COVARIATE MAXMEAN_HRMIN

Identifier not previously declared.

Identifier MAXMEAN_HRMIN has not yet been declared; it should be a variate or pointer , with values present

(See the <unnamed> parameter of the statement.)

```
40 ANOVA [PRINT=aovtable,information,means,covariate; FACT=32; CONTRASTS=7; PCONTRASTS=7;\
41 FPROB=yes; PSE=diff,lsd; LSDLEVEL=5] HRV_lf_hf
```

Analysis of variance

Variate: HRV_lf_hf

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
horse stratum	2	4.5528	2.2764	5.19	
horse.*Units* stratum					
Treatment	2	0.4761	0.2380	0.54	0.619
Residual	4	1.7545	0.4386		
Total	8	6.7834			

Tables of means

Variate: HRV_lf_hf

Grand mean 1.96

Treatment	H	L	S
	1.68	2.24	1.96

Standard errors of differences of means

Table	Treatment
rep.	3
d.f.	4
s.e.d.	0.541

Least significant differences of means (5% level)

Table	Treatment
rep.	3
d.f.	4
l.s.d.	1.501

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```

48 DELETE [REDEFINE=yes] Horse,Blink_Rate_30_mins
49 UNITS [NVALUES=*]
50 FACTOR [MODIFY=no; NVALUES=9; LEVELS=3; LABELS=*; REFERENCE=1] Horse
51 READ Horse; FREPRESENTATION=ordinal

```

Identifier	Values	Missing	Levels
Horse	9	0	3

```

53 FACTOR [MODIFY=yes; NVALUES=9; LEVELS=3; LABELS=!(('H','L','S'))\
54 ; REFERENCE=1] Treatment
55 READ Treatment; FREPRESENTATION=ordinal

```

Identifier	Values	Missing	Levels
Treatment	9	0	3

```

57 VARIATE [NVALUES=9] Blink_Rate_30_mins
58 READ Blink_Rate_30_mins

```

Identifier	Minimum	Mean	Maximum	Values	Missing
Blink_Rate_30_mins	168.0	226.5	341.0	9	0

```

60
61 "General Analysis of Variance"
62 BLOCK horse
63 TREATMENTS Treatment
64 COVARIATE
65 ANOVA [PRINT=aovtable,information,means,covariate; FACT=32; CONTRASTS=7; PCONTRASTS=7;\
66 FPROB=yes; PSE=diff,lsd; LSDLEVEL=5] Blink_Rate_30_mins

```

Analysis of variance

Variate: Blink_Rate_30_mins

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
horse stratum	2	40451.2	20225.6	49.18	
horse.*Units* stratum					
Treatment	2	414.2	207.1	0.50	0.638
Residual	4	1645.1	411.3		
Total	8	42510.6			

Tables of means

Variate: Blink_Rate_30_mins

Grand mean 226.5

Treatment	H	L	S
	217.1	229.7	232.8

Standard errors of differences of means

Table	Treatment
-------	-----------

rep.	3
d.f.	4
s.e.d.	16.56

Least significant differences of means (5% level)

Table	Treatment
rep.	3
d.f.	4
l.s.d.	45.97

Data imported from Clipboard
on: 30-Nov-2016 11:51:30

```
73 DELETE [REDEFINE=yes] BIR_30mins
74 UNITS [NVALUES=*]
75 FACTOR [MODIFY=yes; NVALUES=9; LEVELS=3; LABELS=*; REFERENCE=1] Horse
76 READ Horse; FREPRESENTATION=ordinal
```

Identifier	Values	Missing	Levels
Horse	9	0	3

```
78 FACTOR [MODIFY=yes; NVALUES=9; LEVELS=3; LABELS=!t('H','L','S')\
79 ; REFERENCE=1] Treatment
80 READ Treatment; FREPRESENTATION=ordinal
```

Identifier	Values	Missing	Levels
Treatment	9	0	3

```
82 VARIATE [NVALUES=9] BIR_30mins
83 READ BIR_30mins
```

Identifier	Minimum	Mean	Maximum	Values	Missing
BIR_30mins	3.667	5.630	8.000	9	0

```
85
86 "General Analysis of Variance"
87 BLOCK horse
88 TREATMENTS Treatment
89 COVARIATE
90 ANOVA [PRINT=aovtable,information,means,covariate; FACT=32; CONTRASTS=7; PCONTRASTS=7;\
91 FPROB=yes; PSE=diff,lsd; LSDLEVEL=5] BIR_30mins
```

Analysis of variance

Variate: BIR_30mins

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
horse stratum	2	3.284	1.642	0.47	
horse.*Units* stratum					
Treatment	2	0.914	0.457	0.13	0.880
Residual	4	13.901	3.475		

Total	8	18.099
-------	---	--------

Tables of means

Variate: BIR_30mins

Grand mean 5.63

Treatment	H	L	S
	5.22	5.67	6.00

Standard errors of differences of means

Table	Treatment
rep.	3
d.f.	4
s.e.d.	1.522

Least significant differences of means (5% level)

Table	Treatment
rep.	3
d.f.	4
l.s.d.	4.226

6.2 Repeated Measures (ANOVA) Experiment 1

GenStat Release 15.1 (PC/Windows 7) 20 January 2017 17:35:43

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```
1 SET [WORKINGDIRECTORY='//filestore/staff/mmcolyer']
2 "Data taken from unsaved spreadsheet: New Data;1"
3 DELETE [REDEFINE=yes] _stitle_: TEXT _stitle_
4 READ [PRINT=*; SETNVALUES=yes] _stitle_
7 PRINT [IPRINT=*] _stitle_; JUST=left
```

Data imported from Clipboard
on: 20-Jan-2017 17:36:02

```
8 DELETE [REDEFINE=yes] Horse,Treat,d1,d2,d3
9 UNITS [NVALUES=9]
10 FACTOR [MODIFY=no; NVALUES=9; LEVELS=3; REFERENCE=1] Horse
11 READ Horse; FREPRESENTATION=ordinal
```

Identifier	Values	Missing	Levels
Horse	9	0	3

```
13 FACTOR [MODIFY=no; NVALUES=9; LEVELS=3; LABELS=!(('H','L','S'))\
14 ; REFERENCE=1] Treat
15 READ Treat; FREPRESENTATION=ordinal
```

Identifier	Values	Missing	Levels
Treat	9	0	3

```
17 VARIATE [NVALUES=9] d1
18 READ d1
```

Identifier	Minimum	Mean	Maximum	Values	Missing
d1	5.000	5.667	7.000	9	0

```
20 VARIATE [NVALUES=9] d2
21 READ d2
```

Identifier	Minimum	Mean	Maximum	Values	Missing
d2	2.000	6.111	13.00	9	0

```
23 VARIATE [NVALUES=9] d3
24 READ d3
```

Identifier	Minimum	Mean	Maximum	Values	Missing
d3	2.000	5.111	7.000	9	0

```

26
27 DELETE [REDEFINE=yes] _tempfac
28 AREPMEASURES [PRINT=epsilon,test; APRINT=aovtable,information,mean; TREATMENT=Treat;\
29 BLOCK=Horse; FPROB=yes; PSE=diff,lsc; LSDLEVEL=5; FACT=9; SAVEFACTORS=_tempfac] d1,\
30 d2,d3

```

Message: units are assumed to be in the same order at each time within each combination of the block factors.

Box's tests for symmetry of the covariance matrix

Chi-square 7.77 on 4 degrees of freedom: probability 0.100

F-test 1.91 on 4 and 384 degrees of freedom: probability 0.108

Greenhouse-Geisser epsilon

epsilon 0.6200

Analysis of variance (Behavioural Initiation Rate) 30mins

Variate: d1,d2,d3

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Horse stratum	2	9.852	4.926	0.47	
Horse.Subject stratum					
Treat	2	2.741	1.370	0.13	0.880
Residual	4	41.704	10.426	2.14	
Horse.Subject.Time stratum					
d.f. correction factor 0.6200					
Time	2	4.519	2.259	0.46	0.557
Time.Treat	4	13.037	3.259	0.67	0.570
Residual	12	58.444	4.870		
Total	26	130.296			

(d.f. are multiplied by the correction factors before calculating F probabilities)

Information summary

All terms orthogonal, none aliased.

Message: the following units have large residuals.

Horse 1 Subject 2 Time d2	4.22	s.e. 1.47
---------------------------	------	-----------

Tables of means

Variate: d1,d2,d3

Grand mean 5.63

Time	d1	d2	d3	
	5.67	6.11	5.11	
Treat	H	L	S	
	5.22	5.67	6.00	
Time	Treat	H	L	S
d1		6.00	5.33	5.67
d2		6.00	5.33	7.00
d3		3.67	6.33	5.33

Standard errors of differences of means

Table	Time	Treat	Time Treat
rep.	9	9	3
s.e.d.	1.040	1.522	2.117
d.f.	7.44	4	10.19
Except when comparing means with the same level(s) of Treat			1.802
d.f.			7.44

Correction factors have been applied to residual d.f.(see analysis-of-variance table for details)

Least significant differences of means (5% level)

Table	Time	Treat	Time Treat
rep.	9	9	3
l.s.d.	2.577	4.226	5.022
d.f.	7.44	4	10.19
Except when comparing means with the same level(s) of Treat			4.463
d.f.			7.44

Correction factors have been applied to residual d.f.(see analysis-of-variance table for details)

```

31 "Data taken from unsaved spreadsheet: New Data;1"
32 DELETE [REDEFINE=yes] _stitle_: TEXT _stitle_
33 READ [PRINT=*; SETNVALUES=yes] _stitle_
36 PRINT [IPRINT=*] _stitle_; JUST=left

```

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on: 20-Jan-2017 17:38:11

```

37 DELETE [REDEFINE=yes] Horse,Treatment,C3,C4,C5
38 UNITS [NVALUES=*]
39 FACTOR [MODIFY=no; NVALUES=10; LEVELS=3; REFERENCE=1] Horse
40 READ Horse; FREPRESENTATION=ordinal

```

Identifier	Values	Missing	Levels
Horse	10	1	3

```

42 FACTOR [MODIFY=no; NVALUES=10; LEVELS=3; LABELS=!(t('H','L','S'))\
43 ; REFERENCE=1] Treatment
44 READ Treatment; FREPRESENTATION=ordinal

```

Identifier	Values	Missing	Levels
Treatment	10	1	3

```

46 TEXT [NVALUES=10] C3
47 READ C3

```

Identifier	Minimum	Mean	Maximum	Values	Missing
C3				10	0

```

49 TEXT [NVALUES=10] C4
50 READ C4

```

Identifier	Minimum	Mean	Maximum	Values	Missing
C4				10	0

```

52 TEXT [NVALUES=10] C5
53 READ C5

```

Identifier	Minimum	Mean	Maximum	Values	Missing
C5				10	0

Genstat 64-bit Release 18.1 (PC/Windows 7) 23 January 2017 11:10:54
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```

1 SET [WORKINGDIRECTORY='//filestore/students/10126268/Documents']
2 "Data taken from unsaved spreadsheet: New Data;1"
3 DELETE [REDEFINE=yes] _stitle_: TEXT _stitle_
4 READ [PRINT=*; SETNVALUES=yes] _stitle_
7 PRINT [IPRINT=*] _stitle_; JUST=left

```

Data imported from Clipboard
 on: 23-Jan-2017 11:11:38

```

8 DELETE [REDEFINE=yes] Horse,Treat,d1,d2,d3
9 UNITS [NVALUES=*]
10 FACTOR [MODIFY=no; NVALUES=9; LEVELS=3; LABELS=*; REFERENCE=1] Horse
11 READ Horse; FREPRESENTATION=ordinal

```

Identifier	Values	Missing	Levels
Horse	9	0	3

```

13 FACTOR [MODIFY=no; NVALUES=9; LEVELS=3; LABELS=!(t('H','L','S'))\
14 ; REFERENCE=1] Treat
15 READ Treat; FREPRESENTATION=ordinal

```

Identifier	Values	Missing	Levels
Treat	9	0	3

17 VARIATE [NVALUES=9] d1
18 READ d1

Identifier	Minimum	Mean	Maximum	Values	Missing
d1	142.0	239.4	372.0	9	0

20 VARIATE [NVALUES=9] d2
21 READ d2

Identifier	Minimum	Mean	Maximum	Values	Missing
d2	136.0	227.0	419.0	9	0

23 VARIATE [NVALUES=9] d3
24 READ d3

Identifier	Minimum	Mean	Maximum	Values	Missing
d3	122.0	212.7	314.0	9	0

26
27 DELETE [REDEFINE=yes] _tempfac
28 AREPMEASURES [PRINT=epsilon,test; APRINT=aovtable,information,mean; TREATMENT=Treat;\n29 BLOCK=Horse; FPROB=yes; PSE=diff,lsd; LSDLEVEL=5; FACT=9; SAVEFACTORS=_tempfac] d1,\n30 d2,d3

Message: units are assumed to be in the same order at each time within each combination of the block factors.

Box's tests for symmetry of the covariance matrix

Chi-square 2.72 on 4 degrees of freedom: probability 0.605

F-test 0.67 on 4 and 384 degrees of freedom: probability 0.613

Greenhouse-Geisser epsilon

epsilon 0.7535

Analysis of variance – SPONTANEOUS EYE BLINK RATE (30mins)

Variate: d1,d2,d3

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Horse stratum	2	120890.	60445.	49.01	
Horse.Subject stratum					
Treat	2	1232.	616.	0.50	0.640
Residual	4	4934.	1233.	0.49	
Horse.Subject.Time stratum					
d.f. correction factor 0.7535					
Time	2	3232.	1616.	0.64	0.507
Time.Treat	4	4761.	1190.	0.47	0.711
Residual	12	30329.	2527.		

Total	26	165378.
-------	----	---------

(d.f. are multiplied by the correction factors before calculating F probabilities)

Information summary

All terms orthogonal, none aliased.

Tables of means

Variate: d1,d2,d3

Grand mean 226.4

Time	d1	d2	d3	
	239.4	227.0	212.7	
Treat	H	L	S	
	217.0	229.4	232.7	
Time	Treat	H	L	S
d1		219.0	243.3	256.0
d2		214.0	250.0	217.0
d3		218.0	195.0	225.0

Standard errors of differences of means

Table	Time	Treat	Time
			Treat
rep.	9	9	3
s.e.d.	23.70	16.56	37.38
d.f.	9.04	4	12.33
Except when comparing means with the same level(s) of			
Treat			41.05
d.f.			9.04

Correction factors have been applied to residual d.f.(see analysis-of-variance table for details)

Least significant differences of means (5% level)

Table	Time	Treat	Time
			Treat
rep.	9	9	3
l.s.d.	55.64	45.96	84.61
d.f.	9.04	4	12.33
Except when comparing means with the same level(s) of			
Treat			96.37
d.f.			9.04

Correction factors have been applied to residual d.f.(see analysis-of-variance table for details)

Data imported from Clipboard
on: 23-Jan-2017 11:15:11

```
37 UNITS [NVALUES=*]  
38 FACTOR [MODIFY=yes; NVALUES=9; LEVELS=3; LABELS=*; REFERENCE=1] Horse  
39 READ Horse; FREPRESENTATION=ordinal
```

Identifier	Values	Missing	Levels
Horse	9	0	3

```
41 FACTOR [MODIFY=yes; NVALUES=9; LEVELS=3; LABELS=!( 'H','L','S')\  
42 ; REFERENCE=1] Treat  
43 READ Treat; FREPRESENTATION=ordinal
```

Identifier	Values	Missing	Levels
Treat	9	0	3

```
45 VARIATE [NVALUES=9] d1  
46 READ d1
```

Identifier	Minimum	Mean	Maximum	Values	Missing
d1	55.23	63.37	81.54	9	0

```
48 VARIATE [NVALUES=9] d2  
49 READ d2
```

Identifier	Minimum	Mean	Maximum	Values	Missing
d2	36.03	60.88	81.24	9	0

```
51 VARIATE [NVALUES=9] d3  
52 READ d3
```

Identifier	Minimum	Mean	Maximum	Values	Missing
d3	35.12	53.29	68.21	9	0

```
54  
55 DELETE [REDEFINE=yes] _tempfac  
56 AREPMEASURES [PRINT=epsilon,test; APRINT=aovtable,information,mean; TREATMENT=Treat;\  
57 BLOCK=Horse; FPROB=yes; PSE=diff,lsd; LSDLEVEL=5; FACT=9; SAVEFACTORS=_tempfac] d1,\  
58 d2,d3
```

Message: units are assumed to be in the same order at each time within each combination of the block factors.

Box's tests for symmetry of the covariance matrix

Chi-square 6.30 on 4 degrees of freedom: probability 0.178

F-test 1.55 on 4 and 384 degrees of freedom: probability 0.188

Greenhouse-Geisser epsilon epsilon 0.8096

Analysis of variance – TOTAL INTAKE TIME (2kg)

Variate: d1,d2,d3

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Horse stratum	2	629.86	314.93	1.79	
Horse.Subject stratum					
Treat	2	1019.09	509.55	2.90	0.167
Residual	4	703.51	175.88	2.20	
Horse.Subject.Time stratum					
d.f. correction factor 0.8096					
Time	2	495.70	247.85	3.09	0.098
Time.Treat	4	156.41	39.10	0.49	0.711
Residual	12	961.01	80.08		
Total	26	3965.59			

(d.f. are multiplied by the correction factors before calculating F probabilities)

Information summary

All terms orthogonal, none aliased.

Message: the following units have large residuals.

Horse 3 Subject 2 Time d1 13.1 s.e. 6.0

Tables of means

Variate: d1,d2,d3

Grand mean 59.2

Time	d1	d2	d3	
	63.4	60.9	53.3	
Treat	H	L	S	
	56.9	53.0	67.6	
Time	Treat	H	L	S
d1		59.0	57.6	73.6
d2		63.3	52.4	66.9
d3		48.5	49.2	62.2

Standard errors of differences of means

Table Time Treat Time

			Treat
rep.	9	9	3
s.e.d.	4.22	6.25	8.64
d.f.	9.72	4	10.89
Except when comparing means with the same level(s) of			
Treat			7.31
d.f.			9.72

Correction factors have been applied to residual d.f.(see analysis-of-variance table for details)

Least significant differences of means (5% level)

Table	Time	Treat	Time Treat
rep.	9	9	3
l.s.d.	9.71	17.36	19.62
d.f.	9.72	4	10.89
Except when comparing means with the same level(s) of			
Treat			16.83
d.f.			9.72

Correction factors have been applied to residual d.f.(see analysis-of-variance table for details)

Data imported from Clipboard
on: 23-Jan-2017 11:17:37

65 UNITS [NVALUES=*]
66 FACTOR [MODIFY=yes; NVALUES=9; LEVELS=3; LABELS=*; REFERENCE=1] Horse
67 READ Horse; FREPRESENTATION=ordinal

Identifier	Values	Missing	Levels
Horse	9	0	3

69 FACTOR [MODIFY=yes; NVALUES=9; LEVELS=3; LABELS=!('H','L','S')\
70 ; REFERENCE=1] Treat
71 READ Treat; FREPRESENTATION=ordinal

Identifier	Values	Missing	Levels
Treat	9	0	3

73 VARIATE [NVALUES=9] d1
74 READ d1

Identifier	Minimum	Mean	Maximum	Values	Missing
d1	25.00	28.89	32.00	9	0

76 VARIATE [NVALUES=9] d2
77 READ d2

Identifier	Minimum	Mean	Maximum	Values	Missing
d2	18.00	29.00	41.00	9	0

79 VARIATE [NVALUES=9] d3
80 READ d3

Identifier	Minimum	Mean	Maximum	Values	Missing
d3	18.00	26.67	34.00	9	0

```

82
83 "Data taken from unsaved spreadsheet: New Data;1"
84 DELETE [REDEFINE=yes] _stitle_: TEXT _stitle_
85 READ [PRINT=*, SETNVALUES=yes] _stitle_
88 PRINT [IPRINT=*, _stitle_; JUST=left

```

Data imported from Clipboard
on: 23-Jan-2017 11:18:07

```

89 UNITS [NVALUES=*,
90 FACTOR [MODIFY=yes; NVALUES=9; LEVELS=3; LABELS=*, REFERENCE=1] Horse
91 READ Horse; FREPRESENTATION=ordinal

```

Identifier	Values	Missing	Levels
Horse	9	0	3

```

93 FACTOR [MODIFY=yes; NVALUES=9; LEVELS=3; LABELS=!(('H','L','S'))\
94 ; REFERENCE=1] Treat
95 READ Treat; FREPRESENTATION=ordinal

```

Identifier	Values	Missing	Levels
Treat	9	0	3

```

97 VARIATE [NVALUES=9] d1
98 READ d1

```

Identifier	Minimum	Mean	Maximum	Values	Missing
d1	25.00	28.89	32.00	9	0

```

100 VARIATE [NVALUES=9] d2
101 READ d2

```

Identifier	Minimum	Mean	Maximum	Values	Missing
d2	18.00	29.00	41.00	9	0

```

103 VARIATE [NVALUES=9] d3
104 READ d3

```

Identifier	Minimum	Mean	Maximum	Values	Missing
d3	18.00	26.67	34.00	9	0

```

106
107 DELETE [REDEFINE=yes] _tempfac
108 AREPMEASURES [PRINT=epsilon,test; APRINT=aovtable,information,mean; TREATMENT=Treat;\
109 BLOCK=Horse; FPROB=yes; PSE=diff,lsd; LSDLEVEL=5; FACT=9; SAVEFACTORS=_tempfac] d1,\
110 d2,d3

```

Message: units are assumed to be in the same order at each time within each combination of the block factors.

Box's tests for symmetry of the covariance matrix

Chi-square 1.83 on 4 degrees of freedom: probability 0.768

F-test 0.45 on 4 and 384 degrees of freedom: probability 0.773

Greenhouse-Geisser epsilon

epsilon 0.9890

Analysis of variance – Mins/kg

Variate: d1,d2,d3

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Horse stratum	2	146.30	73.15	1.77	
Horse.Subject stratum					
Treat	2	27.63	13.81	0.33	0.734
Residual	4	165.48	41.37	1.99	
Horse.Subject.Time stratum					
d.f. correction factor 0.9890					
Time	2	31.19	15.59	0.75	0.492
Time.Treat	4	79.93	19.98	0.96	0.463
Residual	12	249.56	20.80		
Total	26	700.07			

(d.f. are multiplied by the correction factors before calculating F probabilities)

Information summary

All terms orthogonal, none aliased.

Message: the following units have large residuals.

Horse 3 Subject 2 Time d1 6.33 s.e. 3.04

Tables of means

Variate: d1,d2,d3

Grand mean 28.19

Time	d1	d2	d3	
	28.89	29.00	26.67	
Treat	H	L	S	
	28.67	26.78	29.11	
Time	Treat	H	L	S
d1		29.67	29.00	28.00
d2		31.67	26.33	29.00
d3		24.67	25.00	30.33

Standard errors of differences of means

Table	Time	Treat	Time Treat
rep.	9	9	3
s.e.d.	2.150	3.032	4.294
d.f.	11.87	4	12.00
Except when comparing means with the same level(s) of Treat			3.723
d.f.			11.87

Correction factors have been applied to residual d.f.(see analysis-of-variance table for details)

Least significant differences of means (5% level)

Table	Time	Treat	Time Treat
rep.	9	9	3
l.s.d.	4.697	8.418	9.371
d.f.	11.87	4	12.00
Except when comparing means with the same level(s) of Treat			8.136
d.f.			11.87

Correction factors have been applied to residual d.f.(see analysis-of-variance table for details)

Data imported from Clipboard
on: 23-Jan-2017 11:19:53

```
117 UNITS [NVALUES=*]
118 FACTOR [MODIFY=yes; NVALUES=9; LEVELS=3; LABELS=*; REFERENCE=1] Horse
119 READ Horse; FREPRESENTATION=ordinal
```

Identifier	Values	Missing	Levels
Horse	9	0	3

```
121 FACTOR [MODIFY=yes; NVALUES=9; LEVELS=3; LABELS=!(('H','L','S'))\
122 ; REFERENCE=1] Treat
123 READ Treat; FREPRESENTATION=ordinal
```

Identifier	Values	Missing	Levels
Treat	9	0	3

```
125 VARIATE [NVALUES=9] d1
126 READ d1
```

Identifier	Minimum	Mean	Maximum	Values	Missing
d1	25.00	32.11	36.00	9	0

```
128 VARIATE [NVALUES=9] d2
129 READ d2
```

Identifier	Minimum	Mean	Maximum	Values	Missing
d2	25.00	34.89	56.00	9	0

131 VARIATE [NVALUES=9] d3
 132 READ d3

Identifier	Minimum	Mean	Maximum	Values	Missing
d3	29.00	39.78	57.00	9	0

134
 135 DELETE [REDEFINE=yes] _tempfac
 136 AREPMEASURES [PRINT=epsilon,test; APRINT=aovtable,information,mean; TREATMENT=Treat;\n
 137 BLOCK=Horse; FPROB=yes; PSE=diff,lsd; LSDLEVEL=5; FACT=9; SAVEFACTORS=_tempfac] d1,\n
 138 d2,d3

Message: units are assumed to be in the same order at each time within each combination of the block factors.

Box's tests for symmetry of the covariance matrix

Chi-square 18.68 on 4 degrees of freedom: probability <0.001

F-test 4.59 on 4 and 384 degrees of freedom: probability 0.001

Greenhouse-Geisser epsilon epsilon 0.6528

Analysis of variance – g/min

Variate: d1,d2,d3

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Horse stratum	2	249.41	124.70	1.03	
Horse.Subject stratum					
Treat	2	451.63	225.81	1.86	0.269
Residual	4	486.15	121.54	2.97	
Horse.Subject.Time stratum					
d.f. correction factor 0.6528					
Time	2	271.19	135.59	3.32	0.101
Time.Treat	4	75.70	18.93	0.46	0.693
Residual	12	490.44	40.87		
Total	26	2024.52			

(d.f. are multiplied by the correction factors before calculating F probabilities)

Information summary

All terms orthogonal, none aliased.

Message: the following units have large residuals.

Horse 3 Subject 2 Time d1	-9.6	s.e. 4.3
---------------------------	------	----------

Tables of means

Variate: d1,d2,d3

Grand mean 35.6

Time	d1	d2	d3	
	32.1	34.9	39.8	
	Treat	H	L	S
		37.1	39.7	30.0
Time	Treat	H	L	S
d1		34.0	34.7	27.7
d2		33.7	41.0	30.0
d3		43.7	43.3	32.3

Standard errors of differences of means

Table	Time	Treat	Time Treat
rep.	9	9	3
s.e.d.	3.01	5.20	6.72
d.f.	7.83	4	9.09
Except when comparing means with the same level(s) of			
Treat			5.22
d.f.			7.83

Correction factors have been applied to residual d.f.(see analysis-of-variance table for details)

Least significant differences of means (5% level)

Table	Time	Treat	Time Treat
rep.	9	9	3
l.s.d.	7.36	14.43	16.06
d.f.	7.83	4	9.09
Except when comparing means with the same level(s) of			
Treat			12.75
d.f.			7.83

Correction factors have been applied to residual d.f.(see analysis-of-variance table for details)

Data imported from Clipboard

on: 23-Jan-2017 11:21:50

145 UNITS [NVALUES=*]

146 FACTOR [MODIFY=yes; NVALUES=9; LEVELS=3; LABELS=*; REFERENCE=1] Horse

147 READ Horse; FREPRESENTATION=ordinal

Identifier	Values	Missing	Levels
------------	--------	---------	--------

Horse	9	0	3
-------	---	---	---

```
149 FACTOR [MODIFY=yes; NVALUES=9; LEVELS=3; LABELS=!(('H','L','S'))\
150 ; REFERENCE=1] Treat
151 READ Treat; FREPRESENTATION=ordinal
```

Identifier	Values	Missing	Levels
Treat	9	0	3

```
153 VARIATE [NVALUES=9] d1
154 READ d1
```

Identifier	Minimum	Mean	Maximum	Values	Missing
d1	3.700	9.078	13.00	9	0

```
156 VARIATE [NVALUES=9] d2
157 READ d2
```

Identifier	Minimum	Mean	Maximum	Values	Missing
d2	6.000	10.43	15.00	9	0

```
159 VARIATE [NVALUES=9] d3
160 READ d3
```

Identifier	Minimum	Mean	Maximum	Values	Missing
d3	6.000	8.622	13.30	9	0

```
162
163 DELETE [REDEFINE=yes] _tempfac
164 AREPMEASURES [PRINT=epsilon,test; APRINT=aovtable,information,mean; TREATMENT=Treat;\
165 BLOCK=Horse; FPROB=yes; PSE=diff,lsd; LSDLEVEL=5; FACT=9; SAVEFACTORS=_tempfac] d1,\
166 d2,d3
```

Message: units are assumed to be in the same order at each time within each combination of the block factors.

Box's tests for symmetry of the covariance matrix

Chi-square 4.51 on 4 degrees of freedom: probability 0.341

F-test 1.11 on 4 and 384 degrees of freedom: probability 0.352

Greenhouse-Geisser epsilon

epsilon 0.7006

Analysis of variance – BITES/MIN (30 mins period)

Variate: d1,d2,d3

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Horse stratum	2	81.207	40.603	25.36	
Horse.Subject stratum					
Treat	2	78.509	39.254	24.52	0.006
Residual	4	6.404	1.601	0.34	

Horse.Subject.Time stratum					
d.f. correction factor 0.7006					
Time	2	15.976	7.988	1.68	0.238
Time.Treat	4	5.156	1.289	0.27	0.833
Residual	12	56.976	4.748		
Total	26	244.227			

(d.f. are multiplied by the correction factors before calculating F probabilities)

Information summary

All terms orthogonal, none aliased.

Tables of means

Variate: d1,d2,d3

Grand mean 9.38

Time	d1	d2	d3	
	9.08	10.43	8.62	
Treat	H	L	S	
	10.54	6.97	10.62	
Time	Treat	H	L	S
d1		10.10	6.13	11.00
d2		12.10	8.00	11.20
d3		9.43	6.77	9.67

Standard errors of differences of means

Table	Time	Treat	Time
			Treat
rep.	9	9	3
s.e.d.	1.027	0.596	1.570
d.f.	8.41	4	10.83
Except when comparing means with the same level(s) of			
Treat			1.779
d.f.			8.41

Correction factors have been applied to residual d.f.(see analysis-of-variance table for details)

Least significant differences of means (5% level)

Table	Time	Treat	Time
			Treat
rep.	9	9	3
l.s.d.	2.460	1.656	3.640
d.f.	8.41	4	10.83
Except when comparing means with the same level(s) of			
Treat			4.261

d.f.

8.41

Correction factors have been applied to residual d.f.(see analysis-of-variance table for details)

Data imported from Clipboard
on: 23-Jan-2017 11:23:33

```
173 DELETE [REDEFINE=yes] treat
174 UNITS [NVALUES=*]
175 FACTOR [MODIFY=yes; NVALUES=9; LEVELS=3; LABELS=*; REFERENCE=1] Horse
176 READ Horse; FREPRESENTATION=ordinal
```

Identifier	Values	Missing	Levels
Horse	9	0	3

```
178 FACTOR [MODIFY=no; NVALUES=9; LEVELS=3; LABELS=!(t('H','L','S'))\
179 ; REFERENCE=1] treat
180 READ treat; FREPRESENTATION=ordinal
```

Identifier	Values	Missing	Levels
treat	9	0	3

```
182 VARIATE [NVALUES=9] d1
183 READ d1
```

Identifier	Minimum	Mean	Maximum	Values	Missing
d1	55.00	67.99	82.00	9	0

```
185 VARIATE [NVALUES=9] d2
186 READ d2
```

Identifier	Minimum	Mean	Maximum	Values	Missing
d2	62.70	78.18	88.00	9	0

```
188 VARIATE [NVALUES=9] d3
189 READ d3
```

Identifier	Minimum	Mean	Maximum	Values	Missing
d3	57.30	83.68	95.70	9	0

```
191
192 DELETE [REDEFINE=yes] _tempfac
193 AREPMEASURES [PRINT=epsilon,test; APRINT=aovtable,information,mean; TREATMENT=Treat;\
194 BLOCK=Horse; FPROB=yes; PSE=diff,lsd; LSDLEVEL=5; FACT=9; SAVEFACTORS=_tempfac] d1,\
195 d2,d3
```

Message: units are assumed to be in the same order at each time within each combination of the block factors.

Box's tests for symmetry of the covariance matrix

Chi-square 10.51 on 4 degrees of freedom: probability 0.033

F-test 2.58 on 4 and 384 degrees of freedom: probability 0.037

Greenhouse-Geisser epsilon epsilon 0.6155

Analysis of variance – CHEWS/MIN

Variate: d1,d2,d3

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Horse stratum	2	634.12	317.06	1.29	
Horse.Subject stratum					
Treat	2	115.89	57.95	0.24	0.801
Residual	4	986.13	246.53	4.77	
Horse.Subject.Time stratum					
d.f. correction factor 0.6155					
Time	2	1140.61	570.31	11.04	0.010
Time.Treat	4	402.01	100.50	1.95	0.209
Residual	12	620.05	51.67		
Total	26	3898.81			

(d.f. are multiplied by the correction factors before calculating F probabilities)

Information summary

All terms orthogonal, none aliased.

Message: the following units have large residuals.

Horse 2 Subject 3 Time d1 -10.9 s.e. 4.8

Tables of means

Variate: d1,d2,d3

Grand mean 76.6

Time	d1	d2	d3	
	68.0	78.2	83.7	
Treat	H	L	S	
	74.4	79.4	76.0	
Time	Treat	H	L	S
d1		69.7	63.9	70.4
d2		76.9	83.6	74.0
d3		76.7	90.7	83.7

Standard errors of differences of means

Table Time Treat Time

			Treat
rep.	9	9	3
s.e.d.	3.39	7.40	8.82
d.f.	7.39	4	7.36
Except when comparing means with the same level(s) of			
Treat			5.87
d.f.			7.39

Correction factors have been applied to residual d.f.(see analysis-of-variance table for details)

Least significant differences of means (5% level)

Table	Time	Treat	Time Treat
rep.	9	9	3
l.s.d.	8.41	20.55	21.90
d.f.	7.39	4	7.36
Except when comparing means with the same level(s) of			
Treat			14.57
d.f.			7.39

Correction factors have been applied to residual d.f.(see analysis-of-variance table for details)

6.3 Analysis of Variance Experiment 2

Genstat Release 18.2 (PC/Windows 7) 22 February 2017 15:27:01

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Genstat Eighteenth Edition
Genstat Procedure Library Release PL26.2

```
1 SET [WORKINGDIRECTORY='C:/Users/Lucy/Documents']
2 "Data taken from unsaved spreadsheet: New Data;1"
3 DELETE [REDEFINE=yes] _stitle_: TEXT _stitle_
4 READ [PRINT=*; SETNVALUES=yes] _stitle_
7 PRINT [IPRINT=*] _stitle_; JUST=left
```

Data imported from Clipboard
on: 22-Feb-2017 15:27:30

```
8 DELETE [REDEFINE=yes] horse,Treatment,Intake_Time_mins,g_min,mins_kg,\
9 Chews_Min,Bites_Min
10 UNITS [NVALUES=*]
11 FACTOR [MODIFY=no; NVALUES=16; LEVELS=4; LABELS=*; REFERENCE=1] horse
12 READ horse; FREPRESENTATION=ordinal
```

Identifier	Values	Missing	Levels
horse	16	0	4

```
14 FACTOR [MODIFY=no; NVALUES=16; LEVELS=4; LABELS=!t('H','L','SG','SN')\
15 ; REFERENCE=1] Treatment
16 READ Treatment; FREPRESENTATION=ordinal
```

Identifier	Values	Missing	Levels
Treatment	16	0	4

```
18 VARIATE [NVALUES=16] Intake_Time_mins
19 READ Intake_Time_mins
```

Identifier	Minimum	Mean	Maximum	Values	Missing
Intake_Time_mins	40.56	61.20	93.58	16	0

```
22 VARIATE [NVALUES=16] g_min
23 READ g_min
```

Identifier	Minimum	Mean	Maximum	Values	Missing
g_min	21.00	36.00	50.00	16	0

```
25 VARIATE [NVALUES=16] mins_kg
26 READ mins_kg
```

Identifier	Minimum	Mean	Maximum	Values	Missing
mins_kg	20.00	30.62	47.00	16	0

```
28 VARIATE [NVALUES=16] Chews_Min
29 READ Chews_Min
```

Identifier	Minimum	Mean	Maximum	Values	Missing	Skew
Chews_Min	66.10	115.7	689.0	16	0	

31 VARIATE [NVALUES=16] Bites_Min
32 READ Bites_Min

Identifier	Minimum	Mean	Maximum	Values	Missing
Bites_Min	7.700	12.41	17.20	16	0

34
35 "General Analysis of Variance"
36 BLOCK horse
37 TREATMENTS Treatment
38 COVARIATE "No Covariate"
39 ANOVA [PRINT=aovtable,information,means; FACT=32; CONTRASTS=7; PCONTRASTS=7;
FPROB=yes;\n
40 PSE=diff,lsd; LSDLEVEL=5] Bites_Min

BITES/MIN

Analysis of variance

Variate: Bites_Min

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
horse stratum	3	28.717	9.572	2.73	
horse.*Units* stratum					
Treatment	3	94.902	31.634	9.01	0.004
Residual	9	31.611	3.512		
Total	15	155.229			

Tables of means

Variate: Bites_Min

Grand mean 12.41

Treatment	H	L	SG	SN
	13.22	8.25	14.40	13.75

Standard errors of differences of means

Table	Treatment
rep.	4
d.f.	9
s.e.d.	1.325

Least significant differences of means (5% level)

Table	Treatment
rep.	4
d.f.	9
l.s.d.	2.998

INTAKE TIME

Analysis of variance

Variate: Intake_Time_mins

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
horse stratum	3	9.82	3.27	0.07	
horse.*Units* stratum					
Treatment	3	4580.02	1526.67	30.81	<.001
Residual	9	445.91	49.55		
Total	15	5035.75			

Message: the following units have large residuals.

horse 3 *units* 4	-10.8	s.e. 5.3
-------------------	-------	----------

Tables of means

Variate: Intake_Time_mins

Grand mean 61.2

Treatment	H	L	SG	SN
	50.1	43.5	87.7	63.4

Standard errors of differences of means

Table	Treatment
rep.	4
d.f.	9
s.e.d.	4.98

Least significant differences of means (5% level)

Table	Treatment
rep.	4
d.f.	9
l.s.d.	11.26

G/MIN

Analysis of variance

Variate: g_min

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
horse stratum	3	1.50	0.50	0.03	
horse.*Units* stratum					
Treatment	3	1305.00	435.00	27.67	<.001
Residual	9	141.50	15.72		
Total	15	1448.00			

Tables of means

Variate: g_min

Grand mean 36.00

Treatment	H	L	SG	SN
	41.25	46.75	22.75	33.25

Standard errors of differences of means

Table	Treatment
rep.	4
d.f.	9
s.e.d.	2.804

Least significant differences of means (5% level)

Table	Treatment
rep.	4
d.f.	9
l.s.d.	6.343

MINS/KG

Analysis of variance

Variate: mins_kg

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
horse stratum	3	1.25	0.42	0.03	
horse.*Units* stratum					

Treatment	3	1169.25	389.75	29.42	<.001
Residual	9	119.25	13.25		
Total	15	1289.75			

Tables of means

Variate: mins_kg

Grand mean 30.62

Treatment	H	L	SG	SN
	25.25	21.50	44.00	31.75

Standard errors of differences of means

Table	Treatment
rep.	4
d.f.	9
s.e.d.	2.574

Least significant differences of means (5% level)

Table	Treatment
rep.	4
d.f.	9
l.s.d.	5.823

BLINK RATE/30mins

Analysis of variance

Variate: Blink_Rate_30_mins

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
horse stratum	3	107577.3	35859.1	58.57	
horse.*Units* stratum					
Treatment	3	3333.5	1111.2	1.82	0.215
Residual	9	5509.7	612.2		
Total	15	116420.6			

Tables of means

Variate: Blink_Rate_30_mins

Grand mean 563.1

Treatment	H	L	SG	SN
-----------	---	---	----	----

543.0 556.0 578.2 575.3

Standard errors of differences of means

Table	Treatment
rep.	4
d.f.	9
s.e.d.	17.50

Least significant differences of means (5% level)

Table	Treatment
rep.	4
d.f.	9
l.s.d.	39.58

BIR /30mins Analysis of variance

Variate: BIR_30mins

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
horse stratum	3	251.6	83.9	0.43	
horse.*Units* stratum					
Treatment	3	869.0	289.7	1.48	0.284
Residual	9	1759.7	195.5		
Total	15	2880.3			

Message: the following units have large residuals.

horse 2 *units* 2 30.6 s.e. 10.5

Tables of means

Variate: BIR_30mins

Grand mean 12.9

Treatment	H	L	SG	SN
	25.6	7.1	9.9	9.2

Standard errors of differences of means

Table	Treatment
rep.	4
d.f.	9

s.e.d. 9.89

Least significant differences of means (5% level)

Table	Treatment
rep.	4
d.f.	9
l.s.d.	22.37

Analysis of variance

Variate: Chews_Min

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Horse stratum	3	497.66	165.89	6.92	
Horse.*Units* stratum					
Treatment	3	2.06	0.69	0.03	0.993
Residual	9	215.67	23.96		
Total	15	715.39			

Information summary

All terms orthogonal, none aliased.

Message: the following units have large residuals.

Horse 3 *units* 3	-8.8	s.e. 3.7
-------------------	------	----------

Tables of means

Variate: Chews_Min

Grand mean 76.9

Treatment	H	L	SG	SN
	76.6	77.5	76.6	77.0

Standard errors of differences of means

Table	Treatment
rep.	4
d.f.	9
s.e.d.	3.46

Least significant differences of means (5% level)

Table	Treatment
rep.	4
d.f.	9
l.s.d.	7.83

Analysis of variance

Variate: HRV_If_hf

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
horse stratum	3	41.439	13.813	6.19	
horse.*Units* stratum					
Treatment	3	11.779	3.926	1.76	0.225
Residual	9	20.092	2.232		
Total	15	73.309			

Information summary

All terms orthogonal, none aliased.

Message: the following units have large residuals.

horse 3 *units* 4	2.79	s.e. 1.12
-------------------	------	-----------

Tables of means

Variate: HRV_If_hf

Grand mean 4.26

Treatment	H	L	SG	SN
	3.67	3.42	4.30	5.64

Standard errors of differences of means

Table	Treatment
rep.	4
d.f.	9
s.e.d.	1.057

```
85 SET [IN=*
```

6.4 Repeated Measures (ANOVA) Experiment 2

Data imported from Clipboard on: 22-Feb-2017 15:52:49

```
36 DELETE [REDEFINE=yes] Horse,Treat,d1,d2,d3
37 UNITS [NVALUES=*]
38 FACTOR [MODIFY=no; NVALUES=16; LEVELS=4; LABELS=*; REFERENCE=1] Horse
39 READ Horse; FREPRESENTATION=ordinal
```

Identifier	Values	Missing	Levels
Horse	16	0	4

```
41 FACTOR [MODIFY=no; NVALUES=16; LEVELS=4; LABELS=!(('H','L','SG','SN')\
42 ; REFERENCE=1] Treat
43 READ Treat; FREPRESENTATION=ordinal
```

Identifier	Values	Missing	Levels
Treat	16	0	4

```
45 VARIATE [NVALUES=16] d1
46 READ d1
```

Identifier	Minimum	Mean	Maximum	Values	Missing
d1	35.07	69.92	96.01	16	0

```
49 VARIATE [NVALUES=16] d2
50 READ d2
```

Identifier	Minimum	Mean	Maximum	Values	Missing
d2	42.59	61.68	94.39	16	0

```
53 VARIATE [NVALUES=16] d3
54 READ d3
```

Identifier	Minimum	Mean	Maximum	Values	Missing
d3	33.53	55.13	90.47	16	0

```
57
58 DELETE [REDEFINE=yes] _tempfac
59 AREPMEASURES [PRINT=epsilon,test; APRINT=aovtable,information,mean; TREATMENT=Treat;\
60 BLOCK=Horse; FPROB=yes; PSE=diff,lsd; LSDLEVEL=5; FACT=9; SAVEFACTORS=_tempfac] d1,\
61 d2,d3
```

Message: units are assumed to be in the same order at each time within each combination of the block factors.

Box's tests for symmetry of the covariance matrix

Chi-square 2.95 on 4 degrees of freedom: probability 0.566

F-test 0.74 on 4 and 1944 degrees of freedom: probability 0.567

Greenhouse-Geisser epsilon 0.9581

Analysis of variance – INTAKE TIME

Variate: d1,d2,d3

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Horse stratum	3	77.87	25.96	0.17	
Horse.Subject stratum					
Treat	3	12927.23	4309.08	27.67	<.001
Residual	9	1401.74	155.75	2.19	
Horse.Subject.Time stratum					
d.f. correction factor 0.9581					
Time	2	1758.22	879.11	12.39	<.001
Time.Treat	6	992.24	165.37	2.33	0.068
Residual	24	1703.36	70.97		
Total	47	18860.66			

(d.f. are multiplied by the correction factors before calculating F probabilities)

Information summary

All terms orthogonal, none aliased.

Message: the following units have large residuals.

Horse 1 Subject 4 Time d2	-15.3	s.e. 6.0
Horse 2 Subject 4 Time d2	13.5	s.e. 6.0
Horse 3 Subject 4 Time d3	14.3	s.e. 6.0

Tables of means

Variate: d1,d2,d3

Grand mean 62.2

Time	d1 69.9	d2 61.7	d3 55.1		
Treat	H 53.8	L 43.5	SG 87.8	SN 63.9	
Time	Treat	H	L	SG	SN
d1		65.6	42.8	93.3	78.0
d2		55.3	45.6	86.4	59.4
d3		40.4	42.1	83.7	54.4

Standard errors of differences of means

Table	Time	Treat	Time
-------	------	-------	------

			Treat
rep.	16	12	4
s.e.d.	2.98	5.09	7.04
d.f.	22.99	9	24.81
Except when comparing means with the same level(s) of			
Treat			5.96
d.f.			22.99

Correction factors have been applied to residual d.f.(see analysis-of-variance table for details)

Least significant differences of means (5% level)

Table	Time	Treat	Time Treat
rep.	16	12	4
l.s.d.	6.20	11.53	14.61
d.f.	22.99	9	24.81
Except when comparing means with the same level(s) of			
Treat			12.41
d.f.			22.99

Correction factors have been applied to residual d.f.(see analysis-of-variance table for details)

Analysis of variance-CHEWS/MIN

Variate: d1,d2,d3

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Horse stratum	3	1500.26	500.09	6.93	
Horse.Subject stratum					
Treat	3	6.37	2.12	0.03	0.993
Residual	9	649.65	72.18	1.69	
Horse.Subject.Time stratum					
d.f. correction factor 0.9047					
Time	2	243.08	121.54	2.84	0.084
Time.Treat	6	571.06	95.18	2.23	0.084
Residual	24	1025.71	42.74		
Total	47	3996.13			

(d.f. are multiplied by the correction factors before calculating F probabilities)

Information summary

All terms orthogonal, none aliased.

Message: the following units have large residuals.

Horse 3 Subject 3	-8.83	s.e. 3.68
Horse 1 Subject 1 Time d3	-13.46	s.e. 4.62

Tables of means

Variate: d1,d2,d3

Grand mean 76.91

Time	d1	d2	d3		
	73.75	78.13	78.84		
Treat	H	L	SG	SN	
	76.56	77.48	76.63	76.95	
Time	Treat	H	L	SG	SN
d1		71.93	80.67	74.32	68.08
d2		76.53	78.60	77.40	80.00
d3		81.23	73.18	78.17	82.78

Standard errors of differences of means

Table	Time	Treat	Time Treat
rep.	16	12	4
s.e.d.	2.311	3.469	5.126
d.f.	21.71	9	27.15
Except when comparing means with the same level(s) of Treat			4.623
d.f.			21.71

Correction factors have been applied to residual d.f.(see analysis-of-variance table for details)

Least significant differences of means (5% level)

Table	Time	Treat	Time Treat
rep.	16	12	4
l.s.d.	4.875	7.846	10.689
d.f.	21.71	9	27.15
Except when comparing means with the same level(s) of Treat			9.749
d.f.			21.71

Correction factors have been applied to residual d.f.(see analysis-of-variance table for details)

Analysis of variance – BITES/MIN

Variate: d1,d2,d3

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Horse stratum	3	71.635	23.878	2.10	

(d.f. are multiplied by the correction factors before calculating F probabilities)

All terms orthogonal, none aliased.

Horse 3 Subject 2 Time d2	-1.78	s.e. 0.72
---------------------------	-------	-----------

Grand mean 12.29

Time	d1	d2	d3		
	11.88	12.14	12.85		
	Treat	H	L	SG	SN
		13.22	8.25	13.93	13.75
Time	Treat	H	L	SG	SN
d1		13.57	8.08	13.03	12.83
d2		13.33	8.08	13.68	13.48
d3		12.76	8.60	15.10	14.93

Table	Time	Treat	Time Treat
rep.	16	12	4
s.e.d.	0.361	1.376	1.497
d.f.	23.06	9	12.45
Except when comparing means with the same level(s) of Treat			0.723
d.f.			23.06

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Least significant differences of means (5% level)

Table	Time	Treat	Time Treat
rep.	16	12	4
l.s.d.	0.752	3.112	3.267
d.f.	23.06	9	12.45
Except when comparing means with the same level(s) of Treat			1.504
d.f.			23.06

Correction factors have been applied to residual d.f.(see analysis-of-variance table for details)

Analysis of variance – G/MIN

Variate: d1,d2,d3

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Horse stratum	3	6.56	2.19	0.04	
Horse.Subject stratum					
Treat	3	3726.06	1242.02	22.18	<.001
Residual	9	504.02	56.00	1.27	
Horse.Subject.Time stratum					
d.f. correction factor 0.7964					
Time	2	266.79	133.40	3.02	0.082
Time.Treat	6	264.87	44.15	1.00	0.442
Residual	24	1059.67	44.15		
Total	47	5827.98			

(d.f. are multiplied by the correction factors before calculating F probabilities)

Information summary

All terms orthogonal, none aliased.

Message: the following units have large residuals.

Horse 1 Subject 1 Time d1	-10.42	s.e. 4.70
Horse 1 Subject 1 Time d3	10.08	s.e. 4.70
Horse 1 Subject 2 Time d3	12.92	s.e. 4.70

Tables of means

Variate: d1,d2,d3

Grand mean 35.85

Time	d1	d2	d3
------	----	----	----

	32.62	36.75	38.19		
	Treat	H	L	SG	SN
		40.50	46.67	23.00	33.25
Time	Treat	H	L	SG	SN
d1		34.25	47.75	21.50	27.00
d2		44.00	44.00	23.25	35.75
d3		43.25	48.25	24.25	37.00

Standard errors of differences of means

Table	Time	Treat	Time
			Treat
rep.	16	12	4
s.e.d.	2.349	3.055	4.904
d.f.	19.11	9	27.53
Except when comparing means with the same level(s) of			
Treat			4.699
d.f.			19.11

Correction factors have been applied to residual d.f.(see analysis-of-variance table for details)

Least significant differences of means (5% level)

Table	Time	Treat	Time
			Treat
rep.	16	12	4
l.s.d.	5.094	6.911	10.433
d.f.	19.11	9	27.53
Except when comparing means with the same level(s) of			
Treat			10.187
d.f.			19.11

Correction factors have been applied to residual d.f.(see analysis-of-variance table for details)

Analysis of variance –mins/kg

Variate: d1,d2,d3

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Horse stratum	3	18.06	6.02	0.14	
Horse.Subject stratum					
Treat	3	3162.06	1054.02	24.21	<.001
Residual	9	391.85	43.54	2.15	
Horse.Subject.Time stratum					
d.f. correction factor 0.9229					
Time	2	379.54	189.77	9.38	0.001
Time.Treat	6	173.13	28.85	1.43	0.251

Residual	24	485.33	20.22
Total	47	4609.98	

(d.f. are multiplied by the correction factors before calculating F probabilities)

Information summary

All terms orthogonal, none aliased.

Message: the following units have large residuals.

Horse 3 Subject 4	-5.85	s.e. 2.86
Horse 1 Subject 4 Time d2	-7.42	s.e. 3.18
Horse 2 Subject 4 Time d2	6.58	s.e. 3.18
Horse 3 Subject 4 Time d3	7.08	s.e. 3.18

Tables of means

Variate: d1,d2,d3

Grand mean 30.48

Time	d1	d2	d3		
	34.25	29.69	27.50		
Treat	H	L	SG	SN	
	25.17	21.75	43.00	32.00	
Time	Treat	H	L	SG	SN
d1		29.75	21.50	46.75	39.00
d2		23.25	22.75	43.00	29.75
d3		22.50	21.00	39.25	27.25

Standard errors of differences of means

Table	Time	Treat	Time Treat
rep.	16	12	4
s.e.d.	1.590	2.694	3.741
d.f.	22.15	9	24.79
Except when comparing means with the same level(s) of Treat			3.180
d.f.			22.15

Correction factors have been applied to residual d.f.(see analysis-of-variance table for details)

Least significant differences of means (5% level)

Table	Time	Treat	Time Treat
-------	------	-------	---------------

rep.	16	12	4
l.s.d.	3.339	6.094	7.810
d.f.	22.15	9	24.79
Except when comparing means with the same level(s) of			
Treat			6.677
d.f.			22.15

Correction factors have been applied to residual d.f.(see analysis-of-variance table for details)

Analysis of variance – blink rate

Variate: d1,d2,d3

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Horse stratum	3	333126.5	111042.2	55.76	
Horse.Subject stratum					
Treat	3	13683.8	4561.3	2.29	0.147
Residual	9	17922.3	1991.4	2.20	
Horse.Subject.Time stratum					
d.f. correction factor 0.7191					
Time	2	1650.0	825.0	0.91	0.389
Time.Treat	6	7728.3	1288.0	1.43	0.267
Residual	24	21683.7	903.5		
Total	47	395794.7			

(d.f. are multiplied by the correction factors before calculating F probabilities)

Information summary

All terms orthogonal, none aliased.

Message: the following units have large residuals.

Horse 2 Subject 3 Time d2	-68.5	s.e. 21.3
Horse 2 Subject 4 Time d1	44.4	s.e. 21.3
Horse 2 Subject 4 Time d2	-47.1	s.e. 21.3
Horse 3 Subject 4 Time d2	50.3	s.e. 21.3

Tables of means

Variate: d1,d2,d3

Grand mean 565.7

Time	d1	d2	d3		
	569.8	557.4	569.8		
Treat	H	L	SG	SN	
	543.1	556.1	578.5	585.0	
Time	Treat	H	L	SG	SN
d1		536.0	564.2	606.8	572.2
d2		550.2	537.5	562.0	579.8
d3		543.0	566.5	566.8	603.0

Standard errors of differences of means

Table	Time	Treat	Time Treat
rep.	16	12	4
s.e.d.	10.63	18.22	25.16
d.f.	17.26	9	22.91
Except when comparing means with the same level(s) of Treat			21.25
d.f.			17.26

Correction factors have been applied to residual d.f.(see analysis-of-variance table for details)

Least significant differences of means (5% level)

Table	Time	Treat	Time Treat
rep.	16	12	4
l.s.d.	23.56	41.21	54.85
d.f.	17.26	9	22.91
Except when comparing means with the same level(s) of Treat			47.11
d.f.			17.26

Correction factors have been applied to residual d.f.(see analysis-of-variance table for details)

Analysis of variance – BIR/30MINS

Variate: d1,d2,d3

Source of variation	d.f.	s.s.	m.s.	v.r.	F pr.
Horse stratum	3	249.73	83.24	2.64	

Horse.Subject stratum					
Treat	3	117.06	39.02	1.24	0.351
Residual	9	283.35	31.48	1.98	
Horse.Subject.Time stratum					
d.f. correction factor 0.9764					
Time	2	66.29	33.15	2.09	0.147
Time.Treat	6	188.37	31.40	1.98	0.111
Residual	24	380.67	15.86		
Total	47	1285.48			

(d.f. are multiplied by the correction factors before calculating F probabilities)

Information summary

All terms orthogonal, none aliased.

Message: the following units have large residuals.

Horse 3 Subject 3 Time d1 7.25 s.e. 2.82

Tables of means

Variate: d1,d2,d3

Grand mean 9.40

Time	d1	d2	d3		
	7.81	9.75	10.62		
Treat	H	L	SG	SN	
	11.42	7.08	9.92	9.17	
Time	Treat	H	L	SG	SN
d1		7.50	5.00	12.00	6.75
d2		14.75	6.00	9.50	8.75
d3		12.00	10.25	8.25	12.00

Standard errors of differences of means

Table	Time	Treat	Time Treat
rep.	16	12	4
s.e.d.	1.408	2.291	3.246
d.f.	23.43	9	26.10
Except when comparing means with the same level(s) of			
Treat			2.816
d.f.			23.43

Correction factors have been applied to residual d.f.(see analysis-of-variance table for details)

Least significant differences of means (5% level)

Table	Time	Treat	Time Treat
rep.	16	12	4
l.s.d.	2.921	5.182	6.696
d.f.	23.43	9	26.10
Except when comparing means with the same level(s) of Treat			5.842
d.f.			23.43

Correction factors have been applied to residual d.f.(see analysis-of-variance table for details)

Appendix 7: Kubios HRV Analysis Results Experiment 1

Appendix 8: Kubios HRV Analysis Results Experiment 2

Appendix 7: Kubios HRV Analysis Results Experiment 1

HRV Analysis Results

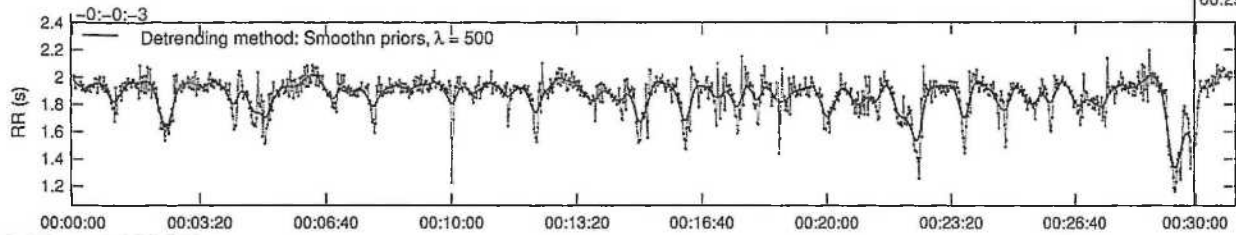
Abdullah baseline HR data 1 14 09 16.txt - xx/xx/xx - xx:xx:xx

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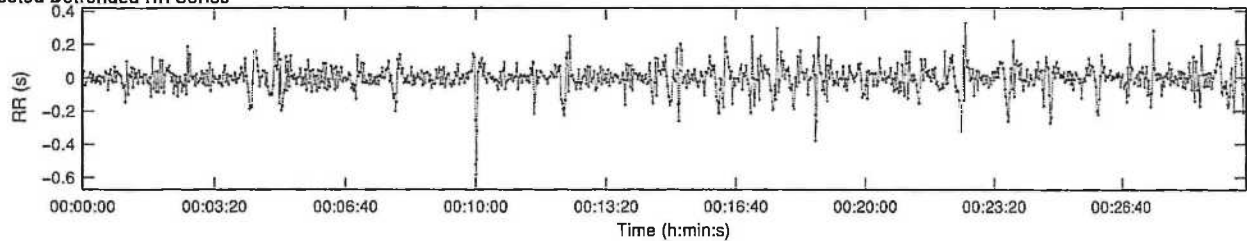
RR Interval Time Series

Results for a single sample

00:29:57



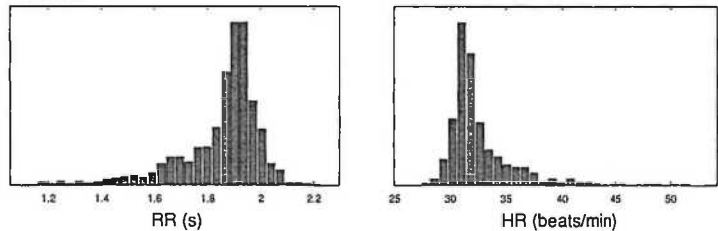
Selected Detrended RR Series



Time-Domain Results

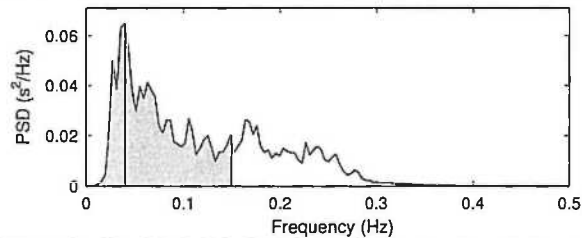
Variable	Units	Value
Mean RR*	(ms)	1852.7
STD RR (SDNN)	(ms)	85.8
Mean HR*	(1/min)	32.63
STD HR	(1/min)	2.70
RMSSD	(ms)	101.2
NN50	(count)	532
pNN50	(%)	53.7
RR triangular index		14.362
TINN	(ms)	630.0

Distributions*



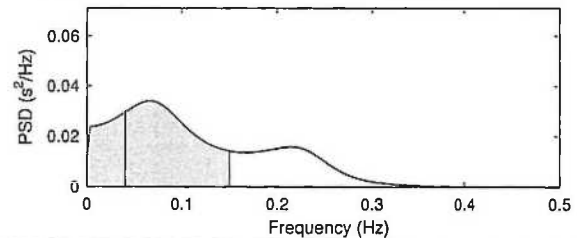
Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	895	16.4	
LF (0.04-0.15 Hz)	0.0430	2710	49.6	59.2
HF (0.15-0.4 Hz)	0.1641	1864	34.1	40.7
Total		5468		
LF/HF		1.454		

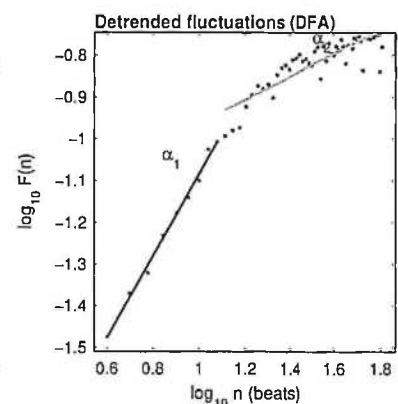
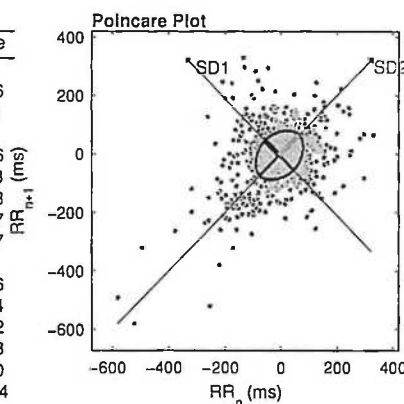
AR Spectrum (AR model order = 16, not factorized)



Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	1001	18.1	
LF (0.04-0.15 Hz)	0.0664	2793	50.6	61.8
HF (0.15-0.4 Hz)	0.2148	1727	31.3	38.2
Total		5521		
LF/HF		1.617		

Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	71.6
SD2	(ms)	98.1
Recurrence plot		
Mean line length (Lmean)	(beats)	12.16
Max line length (Lmax)	(beats)	83
Recurrence rate (REC)	(%)	38.23
Determinism (DET)	(%)	98.57
Shannon Entropy (ShanEn)		3.347
Other		
Approximate entropy (ApEn)		1.376
Sample entropy (SampEn)		1.484
Detrended fluctuations (DFA): α_1		0.982
Detrended fluctuations (DFA): α_2		0.278
Correlation dimension (D2)		3.740
Multiscale entropy (MSE)		0.205 - 1.484



*Results are calculated from the non-detrended selected RR series.

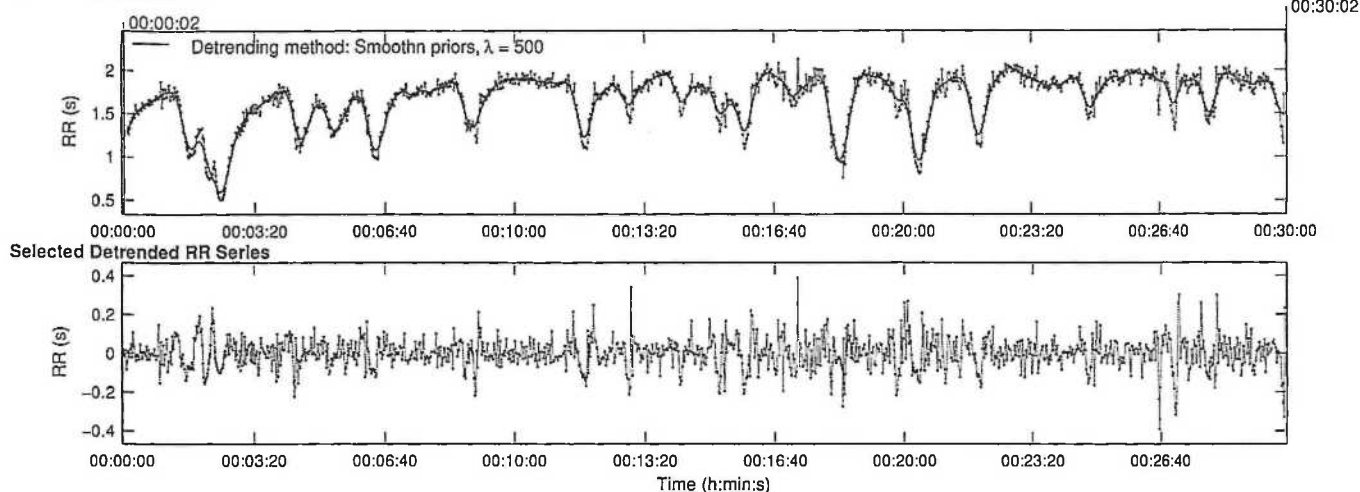
HRV Analysis Results

Abdullah baseline HR data 2 15 09 16.txt - xx/xx/xx - xx:xx:xx

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RR Interval Time Series

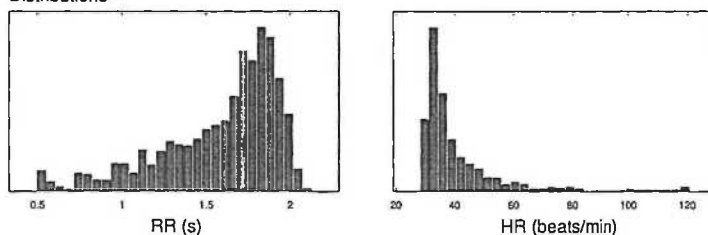
Results for a single sample



Time-Domain Results

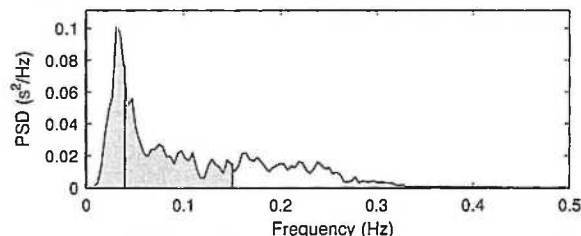
Variable	Units	Value
Mean RR*	(ms)	1589.1
STD RR (SDNN)	(ms)	84.6
Mean HR*	(1/min)	40.73
STD HR	(1/min)	8.64
RMSSD	(ms)	97.1
NN50	(count)	574
pNN50	(%)	50.6
RR triangular index		16.706
TINN	(ms)	555.0

Distributions*



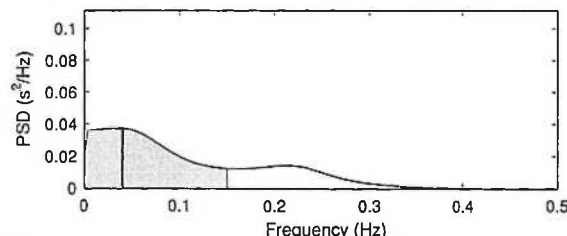
Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0313	1609	27.6	
LF (0.04-0.15 Hz)	0.0469	2408	41.3	57.1
HF (0.15-0.4 Hz)	0.1641	1811	31.1	42.9
Total		5828		
LF/HF		1.330		

AR Spectrum (AR model order = 16, not factorized)

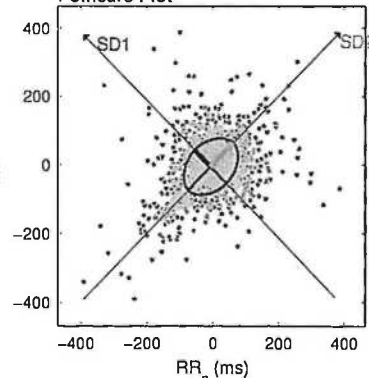


Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0352	1438	25.4	
LF (0.04-0.15 Hz)	0.0430	2532	44.8	60.0
HF (0.15-0.4 Hz)	0.2148	1684	29.8	39.9
Total		5655		
LF/HF		1.503		

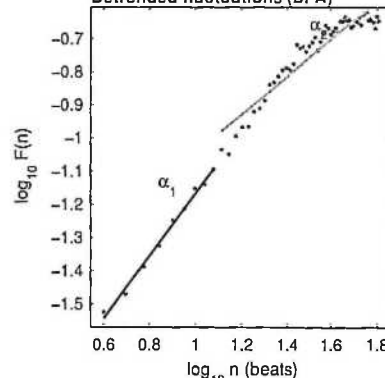
Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	68.7
SD2	(ms)	97.7
Recurrence plot		
Mean line length (Lmean)	(beats)	9.44
Max line length (Lmax)	(beats)	104
Recurrence rate (REC)	(%)	27.07
Determinism (DET)	(%)	97.17
Shannon Entropy (ShanEn)		3.043
Other		
Approximate entropy (ApEn)		1.466
Sample entropy (SampEn)		1.657
Detrended fluctuations (DFA): α_1		0.941
Detrended fluctuations (DFA): α_2		0.569
Correlation dimension (D2)		4.760
Multiscale entropy (MSE)		0.543 - 1.657

Poincare Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

HRV Analysis Results

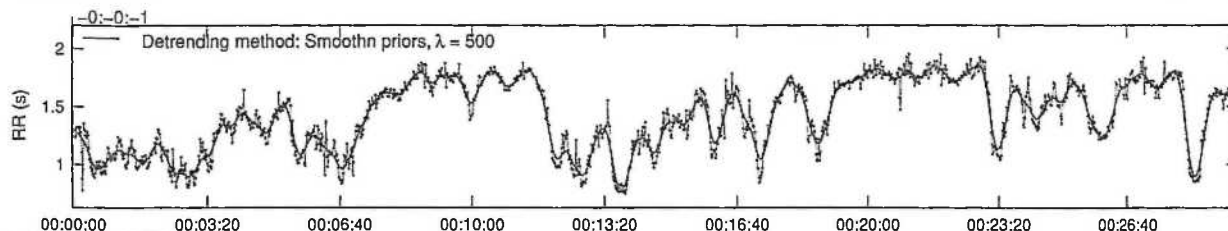
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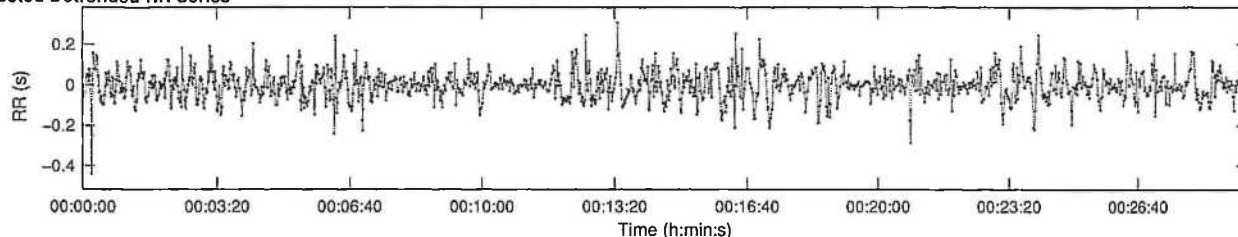
RR Interval Time Series

Results for a single sample

00:29:31



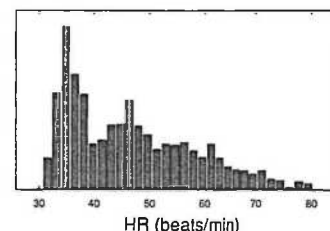
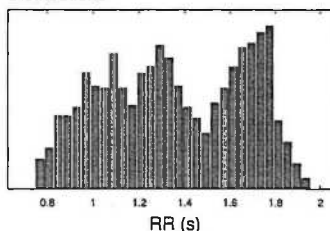
Selected Detrended RR Series



Time-Domain Results

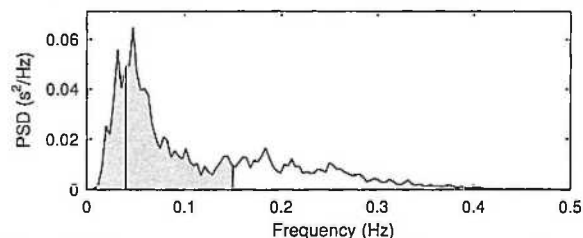
Variable	Units	Value
Mean RR*	(ms)	1359.4
STD RR (SDNN)	(ms)	72.4
Mean HR*	(1/min)	46.67
STD HR	(1/min)	6.72
RMSSD	(ms)	72.6
NN50	(count)	489
pNN50	(%)	37.1
RR triangular index		17.587
TINN	(ms)	535.0

Distributions*



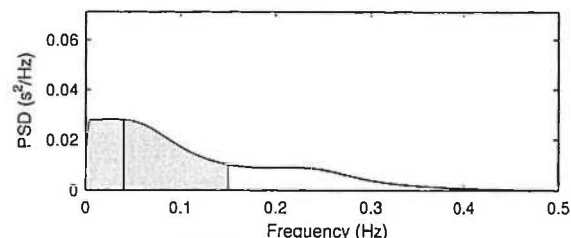
Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0313	883	19.3	
LF (0.04-0.15 Hz)	0.0469	2252	49.2	61.0
HF (0.15-0.4 Hz)	0.1836	1438	31.4	39.0
Total		4574		
LF/HF		1.566		

AR Spectrum (AR model order = 16, not factorized)

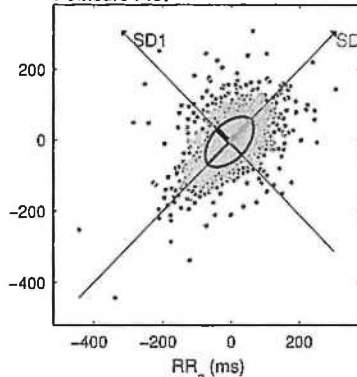


Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0273	1098	24.2	
LF (0.04-0.15 Hz)	0.0430	2071	45.6	60.2
HF (0.15-0.4 Hz)	0.1523	1367	30.1	39.7
Total		4538		
LF/HF		1.515		

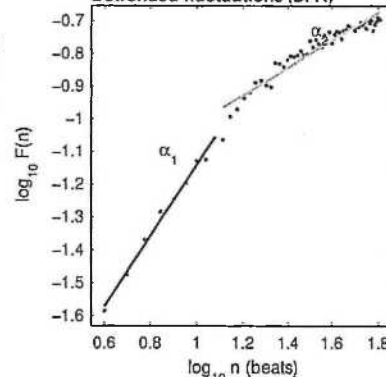
Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	51.3
SD2	(ms)	88.6
Recurrence plot		
Mean line length (Lmean)	(beats)	8.84
Max line length (Lmax)	(beats)	100
Recurrence rate (REC)	(%)	26.85
Determinism (DET)	(%)	97.14
Shannon Entropy (ShanEn)		2.927
Other		
Approximate entropy (ApEn)		1.440
Sample entropy (SampEn)		1.616
Detrended fluctuations (DFA): α1		1.077
Detrended fluctuations (DFA): α2		0.422
Correlation dimension (D2)		4.442
Multiscale entropy (MSE)		0.373 - 1.616

Poincare Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

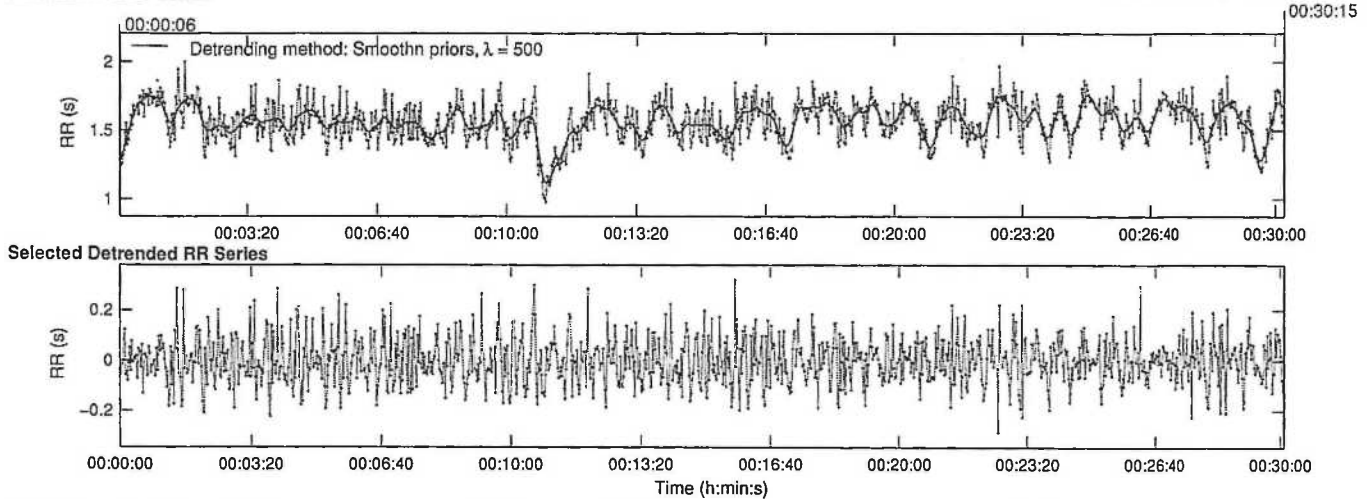
HRV Analysis Results

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RR Interval Time Series

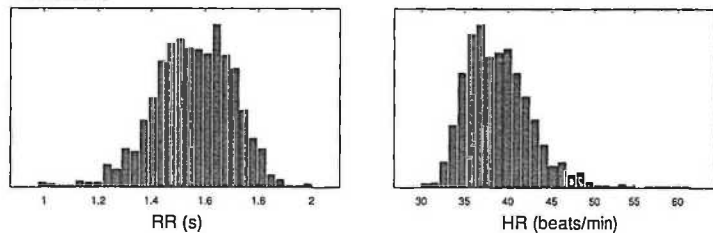
Results for a single sample



Time-Domain Results

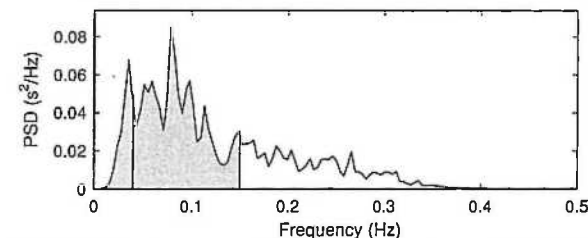
Variable	Units	Value
Mean RR*	(ms)	1556.2
STD RR (SDNN)	(ms)	90.2
Mean HR*	(1/min)	38.93
STD HR	(1/min)	3.47
RMSSD	(ms)	115.3
NN50	(count)	706
pNN50	(%)	60.7
RR triangular index		23.300
TINN	(ms)	475.0

Distributions*



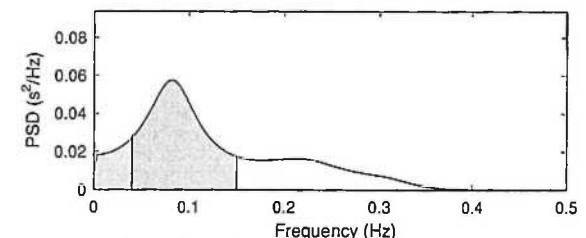
Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



Frequency Band	Peak (Hz)	Power (ms^2)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0352	855	11.3	
LF (0.04-0.15 Hz)	0.0781	4305	56.8	64.0
HF (0.15-0.4 Hz)	0.1641	2421	31.9	36.0
Total		7582		
LF/HF		1.778		

AR Spectrum (AR model order = 16, not factorized)

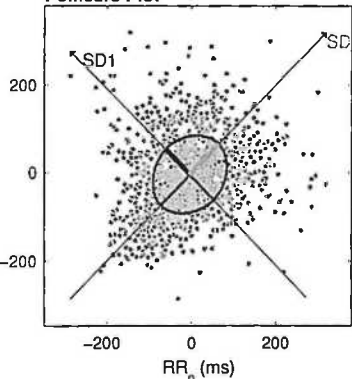


Frequency Band	Peak (Hz)	Power (ms^2)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	818	11.2	
LF (0.04-0.15 Hz)	0.0820	4147	57.0	64.3
HF (0.15-0.4 Hz)	0.1523	2306	31.7	35.7
Total		7271		
LF/HF		1.798		

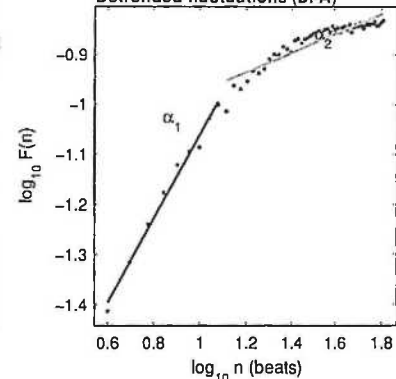
Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	81.6
SD2	(ms)	98.2
Recurrence plot		
Mean line length (Lmean)	(beats)	5.79
Max line length (Lmax)	(beats)	42
Recurrence rate (REC)	(%)	15.52
Determinism (DET)	(%)	93.48
Shannon Entropy (ShanEn)		2.447
Other		
Approximate entropy (ApEn)		1.622
Sample entropy (SampEn)		2.018
Detrended fluctuations (DFA): α_1		0.841
Detrended fluctuations (DFA): α_2		0.193
Correlation dimension (D2)		1.925
Multiscale entropy (MSE)		0.241 - 2.018

Poincare Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

HRV Analysis Results

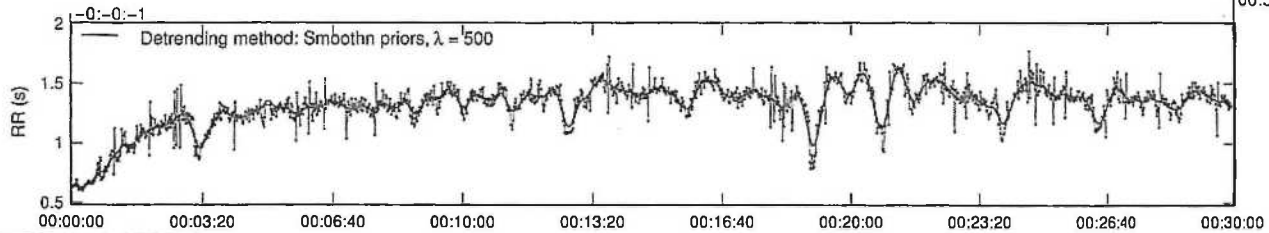
Abdullah day 10 11 11 16 loose hay.txt - xx/xx/xx - xx:xx:xx

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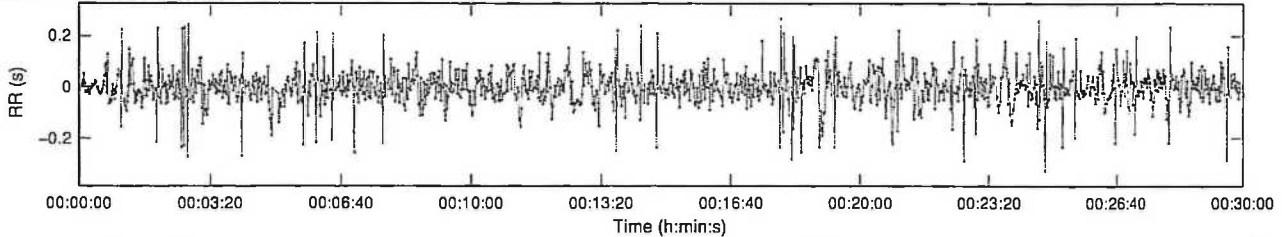
RR Interval Time Series

Results for a single sample

00:30:01



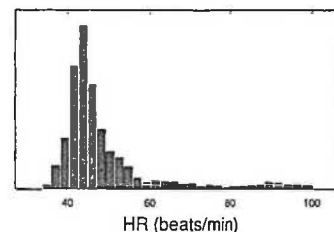
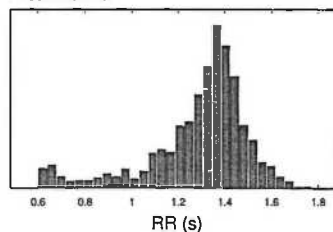
Selected Detrended RR Series



Time-Domain Results

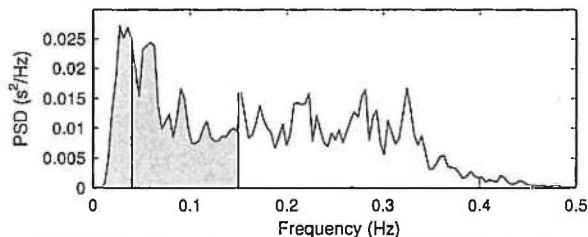
Variable	Units	Value
Mean RR*	(ms)	1284.8
STD RR (SDNN)	(ms)	69.8
Mean HR*	(1/min)	48.67
STD HR	(1/min)	4.44
RMSSD	(ms)	98.5
NN50	(count)	577
pNN50	(%)	41.1
RR triangular index		12.649
TINN	(ms)	425.0

Distributions*



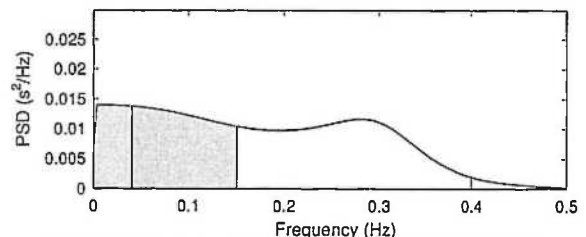
Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0273	525	12.6	
LF (0.04-0.15 Hz)	0.0586	1408	33.9	38.8
HF (0.15-0.4 Hz)	0.3242	2216	53.4	61.1
Total		4152		
LF/HF		0.636		

AR Spectrum (AR model order = 16, not factorized)

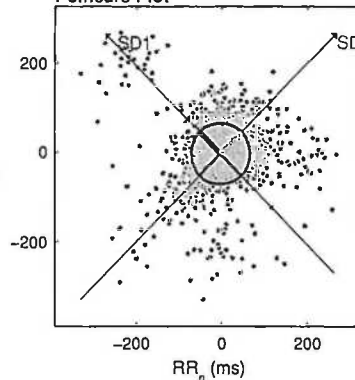


Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0039	544	13.4	
LF (0.04-0.15 Hz)	0.0430	1354	33.3	38.4
HF (0.15-0.4 Hz)	0.2813	2168	53.3	61.5
Total		4069		
LF/HF		0.624		

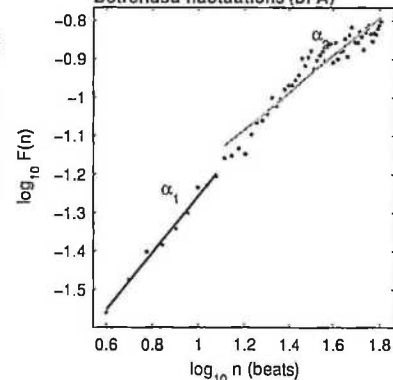
Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	69.7
SD2	(ms)	69.9
Recurrence plot		
Mean line length (Lmean)	(beats)	9.36
Max line length (Lmax)	(beats)	72
Recurrence rate (REC)	(%)	33.00
Determinism (DET)	(%)	97.69
Shannon Entropy (ShanEn)		3.045
Other		
Approximate entropy (ApEn)		1.506
Sample entropy (SampEn)		1.612
Detrended fluctuations (DFA): α1		0.738
Detrended fluctuations (DFA): α2		0.483
Correlation dimension (D2)		4.470
Multiscale entropy (MSE)		0.324 - 1.612

Poincare Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

HRV Analysis Results

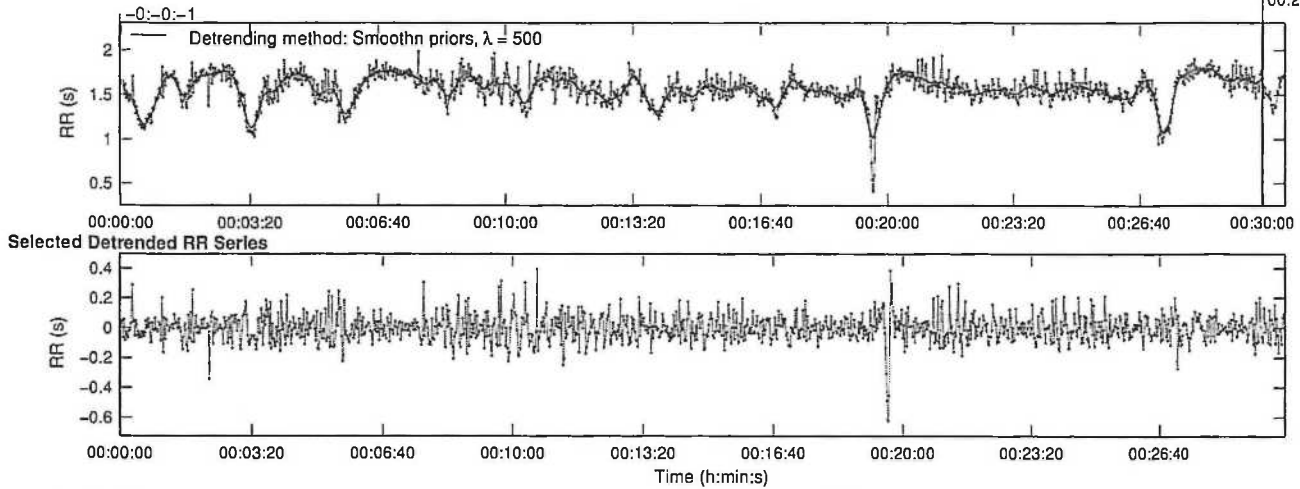
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RR Interval Time Series

Results for a single sample

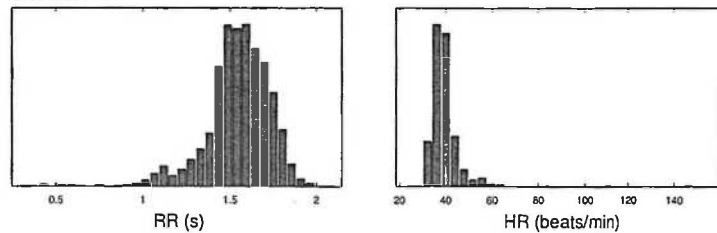
00:29:59



Time-Domain Results

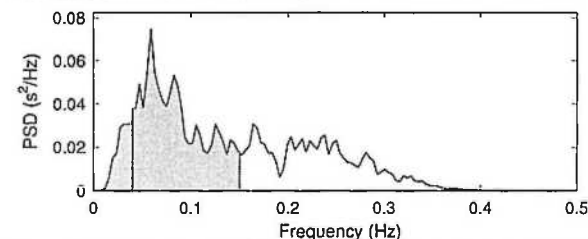
Variable	Units	Value
Mean RR*	(ms)	1548.0
STD RR (SDNN)	(ms)	92.3
Mean HR*	(1/min)	39.52
STD HR	(1/min)	6.56
RMSSD	(ms)	123.6
NN50	(count)	730
pNN50	(%)	62.9
RR triangular index		21.925
TINN	(ms)	720.0

Distributions*



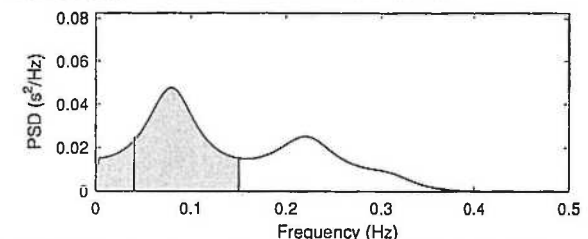
Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	594	8.1	
LF (0.04-0.15 Hz)	0.0586	3781	51.4	56.0
HF (0.15-0.4 Hz)	0.1641	2976	40.5	44.0
Total		7351		
LF/HF		1.271		

AR Spectrum (AR model order = 16, not factorized)

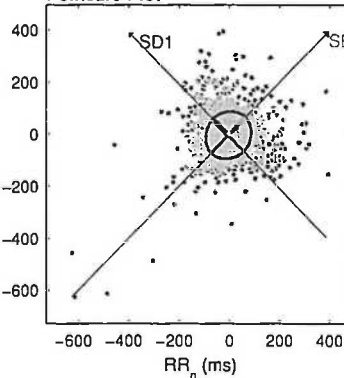


Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	685	9.8	
LF (0.04-0.15 Hz)	0.0781	3396	48.5	53.8
HF (0.15-0.4 Hz)	0.2188	2915	41.7	46.2
Total		6997		
LF/HF		1.165		

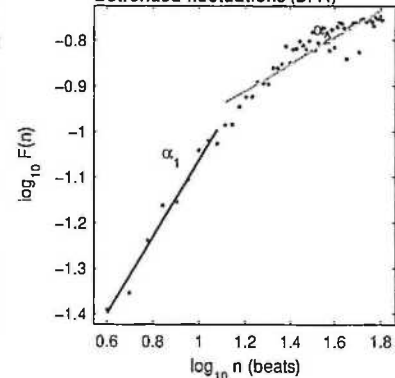
Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	87.5
SD2	(ms)	97.0
Recurrence plot		
Mean line length (Lmean)	(beats)	8.03
Max line length (Lmax)	(beats)	74
Recurrence rate (REC)	(%)	26.43
Determinism (DET)	(%)	96.24
Shannon Entropy (ShanEn)		2.851
Other		
Approximate entropy (ApEn)		1.570
Sample entropy (SampEn)		1.862
Detrended fluctuations (DFA): α1		0.843
Detrended fluctuations (DFA): α2		0.294
Correlation dimension (D2)		4.815
Multiscale entropy (MSE)		0.207 - 1.862

Poincare Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

HRV Analysis Results

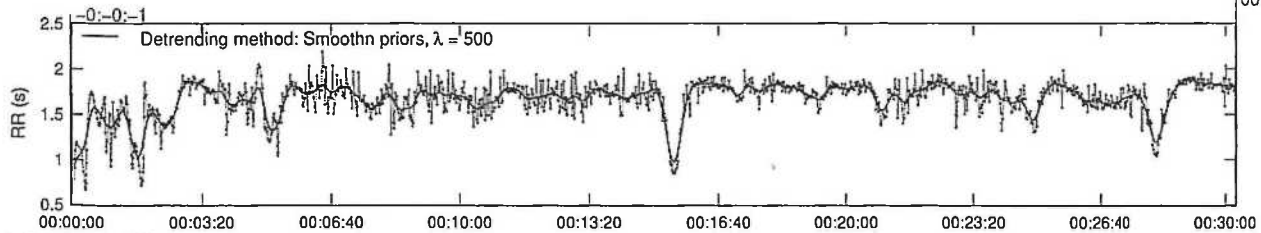
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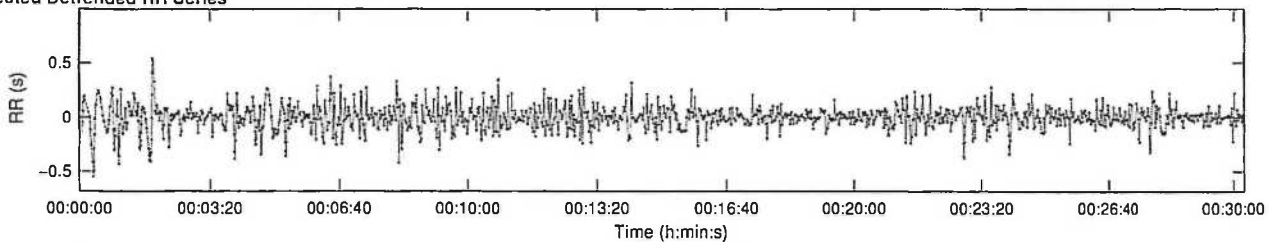
RR Interval Time Series

Results for a single sample

00:30:17



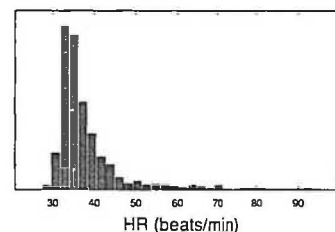
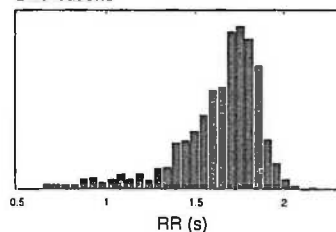
Selected Detrended RR Series



Time-Domain Results

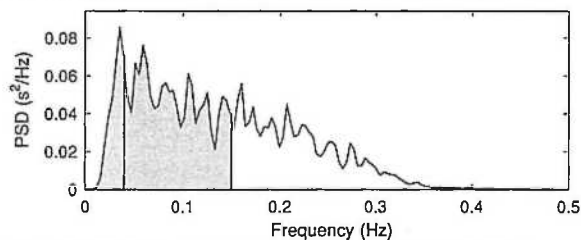
Variable	Units	Value
Mean RR*	(ms)	1630.8
STD RR (SDNN)	(ms)	128.0
Mean HR*	(1/min)	37.98
STD HR	(1/min)	6.32
RMSSD	(ms)	139.9
NN50	(count)	722
pNN50	(%)	61.8
RR triangular index		23.857
TINN	(ms)	970.0

Distributions*



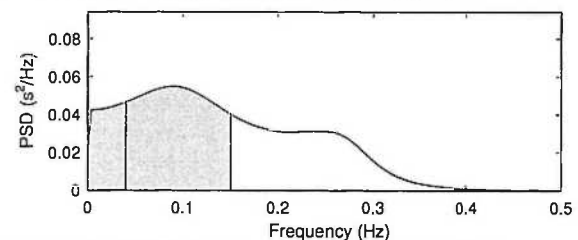
Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0352	1242	11.3	
LF (0.04-0.15 Hz)	0.0586	5301	48.4	54.6
HF (0.15-0.4 Hz)	0.1602	4415	40.3	45.4
Total		10960		
LF/HF		1.201		

AR Spectrum (AR model order = 16, not factorized)

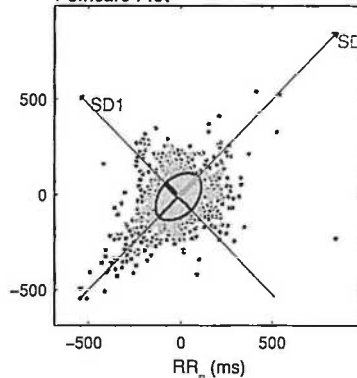


Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	1703	13.9	
LF (0.04-0.15 Hz)	0.0898	5516	44.9	52.2
HF (0.15-0.4 Hz)	0.1523	5052	41.2	47.8
Total		12273		
LF/HF		1.092		

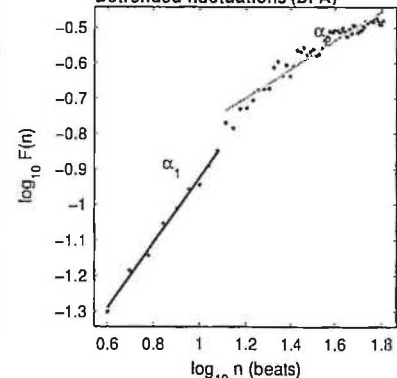
Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	99.0
SD2	(ms)	149.5
Recurrence plot		
Mean line length (Lmean)	(beats)	11.20
Max line length (Lmax)	(beats)	197
Recurrence rate (REC)	(%)	35.76
Determinism (DET)	(%)	97.81
Shannon Entropy (ShanEn)		3.193
Other		
Approximate entropy (ApEn)		1.443
Sample entropy (SampEn)		1.547
Detrended fluctuations (DFA): α1		0.917
Detrended fluctuations (DFA): α2		0.406
Correlation dimension (D2)		4.556
Multiscale entropy (MSE)		0.294 - 1.547

Poincare Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

HRV Analysis Results

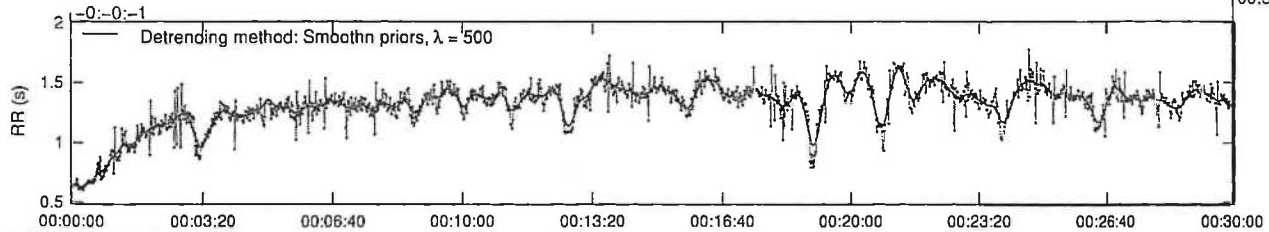
Abdullah day 10 11 11 16 loose hay.txt - xx/xx/xx - xx:xx:xx

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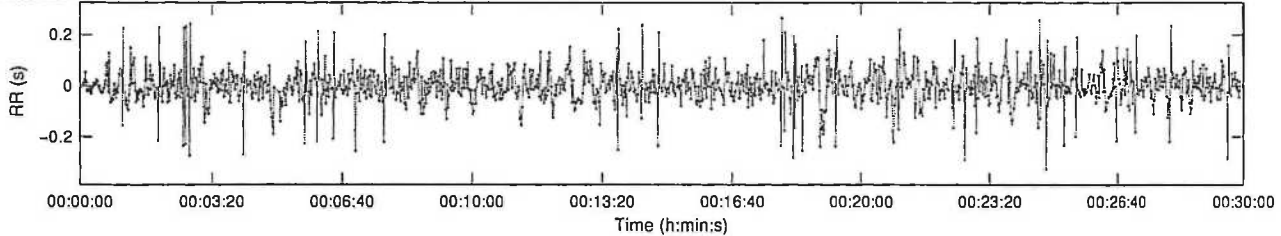
RR Interval Time Series

Results for a single sample

00:30:01



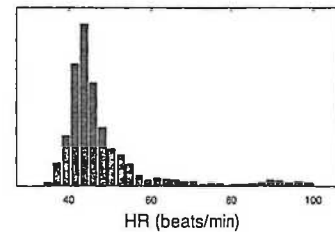
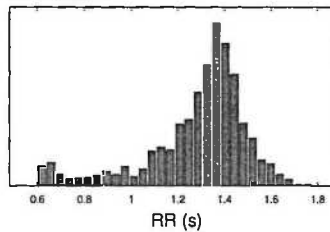
Selected Detrended RR Series



Time-Domain Results

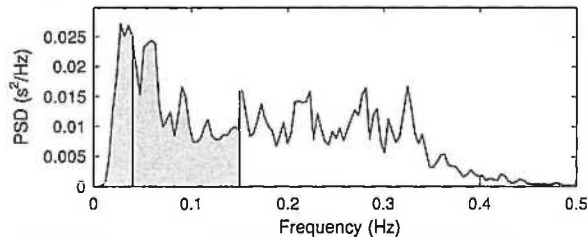
Variable	Units	Value
Mean RR*	(ms)	1284.8
STD RR (SDNN)	(ms)	69.8
Mean HR*	(1/min)	48.67
STD HR	(1/min)	4.44
RMSSD	(ms)	98.5
NN50	(count)	577
pNN50	(%)	41.1
RR triangular index		12.649
TINN	(ms)	425.0

Distributions*



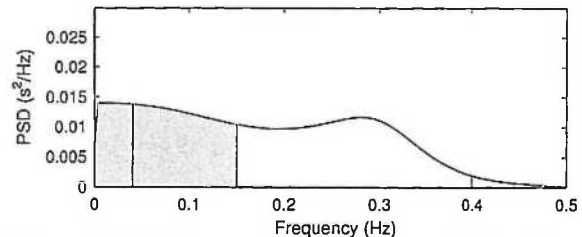
Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0273	525	12.6	
LF (0.04-0.15 Hz)	0.0586	1408	33.9	38.8
HF (0.15-0.4 Hz)	0.3242	2216	53.4	61.1
Total		4152		
LF/HF		0.636		

AR Spectrum (AR model order = 16, not factorized)

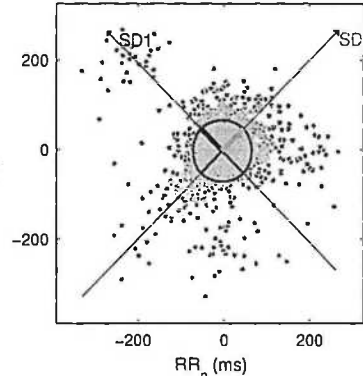


Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0039	544	13.4	
LF (0.04-0.15 Hz)	0.0430	1354	33.3	38.4
HF (0.15-0.4 Hz)	0.2813	2168	53.3	61.5
Total		4069		
LF/HF		0.624		

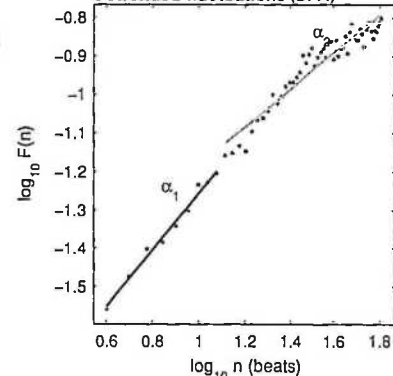
Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	69.7
SD2	(ms)	69.9
Recurrence plot		
Mean line length (Lmean)	(beats)	9.36
Max line length (Lmax)	(beats)	72
Recurrence rate (REC)	(%)	33.00
Determinism (DET)	(%)	97.69
Shannon Entropy (ShanEn)		3.045
Other		
Approximate entropy (ApEn)		1.506
Sample entropy (SampEn)		1.612
Detrended fluctuations (DFA): α_1		0.738
Detrended fluctuations (DFA): α_2		0.483
Correlation dimension (D2)		4.470
Multiscale entropy (MSE)		0.324 - 1.612

Poincare Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

HRV Analysis Results

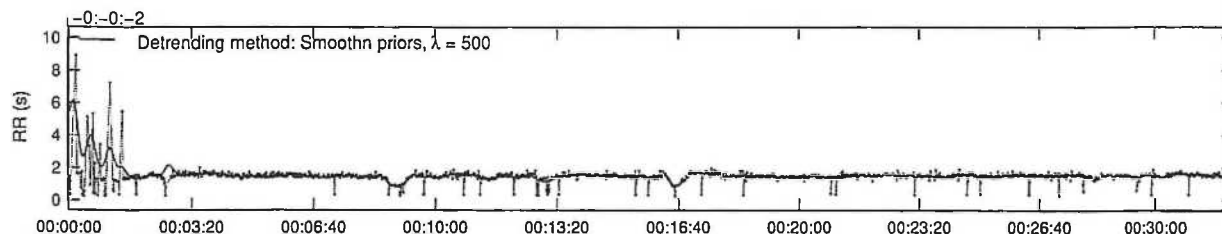
ABDULLAH HR data 3 day 21 haynet.txt - xx/xx/xx - xx:xx:xx

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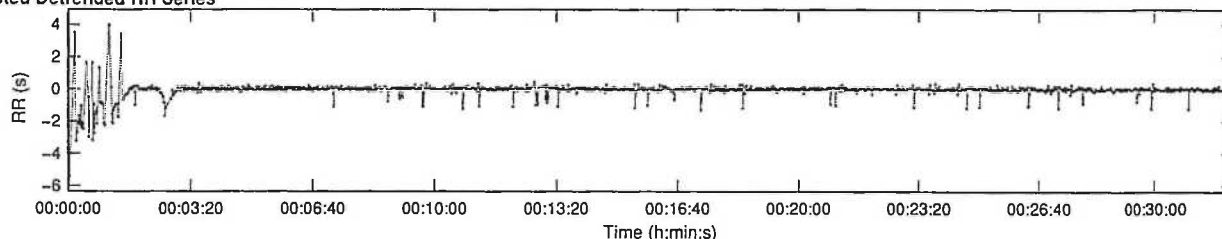
RR Interval Time Series

Results for a single sample

00:32:10



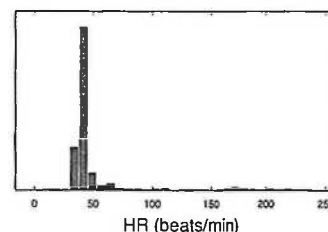
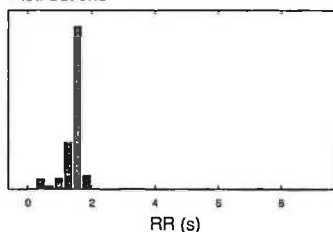
Selected Detrended RR Series



Time-Domain Results

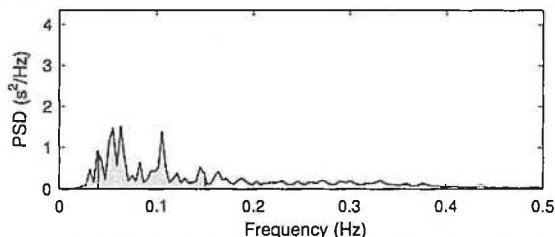
Variable	Units	Value
Mean RR*	(ms)	1437.9
STD RR (SDNN)	(ms)	524.0
Mean HR*	(1/min)	47.56
STD HR	(1/min)	26.63
RMSSD	(ms)	555.5
NN50	(count)	903
pNN50	(%)	67.5
RR triangular index		25.245
TINN	(ms)	2000.0

Distributions*



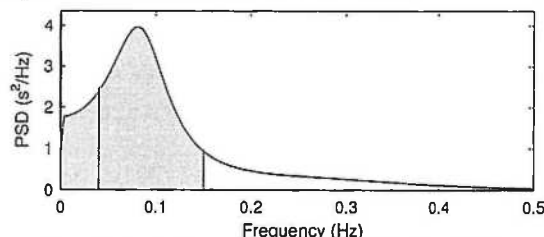
Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	5726	6.0	
LF (0.04-0.15 Hz)	0.0625	54996	57.9	61.6
HF (0.15-0.4 Hz)	0.1641	34246	36.0	38.3
Total		95065		
LF/HF		1.606		

AR Spectrum (AR model order = 16, not factorized)

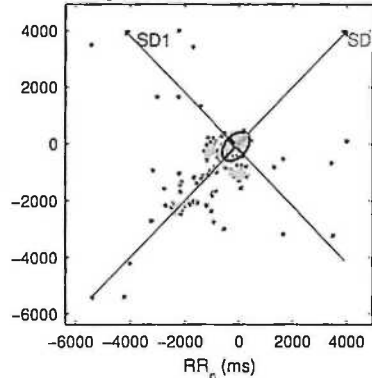


Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	76709	16.9	
LF (0.04-0.15 Hz)	0.0820	294269	64.9	78.1
HF (0.15-0.4 Hz)	0.1523	82358	18.2	21.9
Total		453562		
LF/HF		3.573		

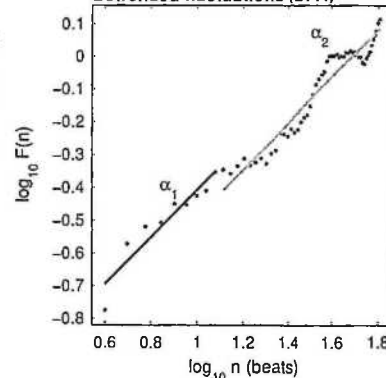
Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	392.9
SD2	(ms)	619.3
Recurrence plot		
Mean line length (Lmean)	(beats)	153.83
Max line length (Lmax)	(beats)	865
Recurrence rate (REC)	(%)	85.50
Determinism (DET)	(%)	99.99
Shannon Entropy (ShanEn)		4.753
Other		
Approximate entropy (ApEn)		0.605
Sample entropy (SampEn)		0.415
Detrended fluctuations (DFA): α1		0.719
Detrended fluctuations (DFA): α2		0.711
Correlation dimension (D2)		1.666
Multiscale entropy (MSE)		0.046 - 0.415

Poincare Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

HRV Analysis Results

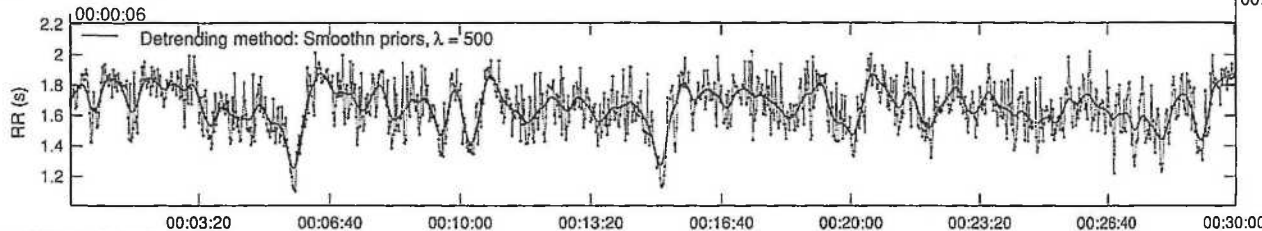
ABDULLAH DAY 21 SLOW FEEDER 01 11 16 editedddd.txt - xx/xx/xx - xx:xx:xx

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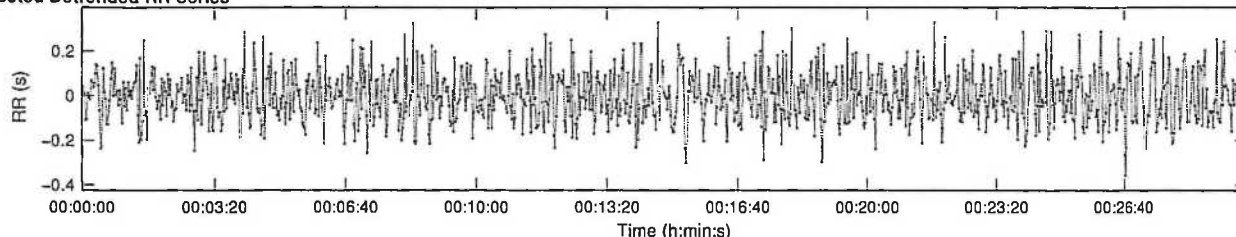
RR Interval Time Series

Results for a single sample

00:00:06 00:30:03



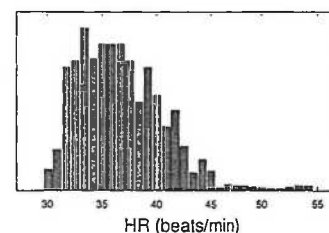
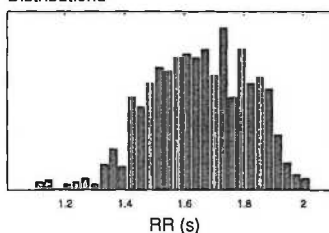
Selected Detrended RR Series



Time-Domain Results

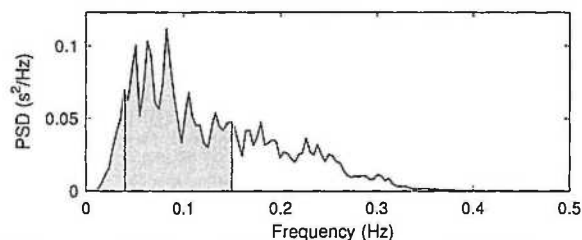
Variable	Units	Value
Mean RR*	(ms)	1649.8
STD RR (SDNN)	(ms)	112.2
Mean HR*	(1/min)	36.78
STD HR	(1/min)	3.63
RMSSD	(ms)	148.5
NN50	(count)	739
pNN50	(%)	68.0
RR triangular index		26.512
TINN	(ms)	585.0

Distributions*



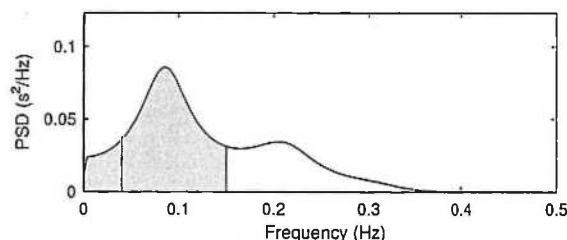
Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	791	6.9	
LF (0.04-0.15 Hz)	0.0820	6728	58.5	62.8
HF (0.15-0.4 Hz)	0.1797	3983	34.6	37.2
Total		11502		
LF/HF		1.689		

AR Spectrum (AR model order = 16, not factorized)

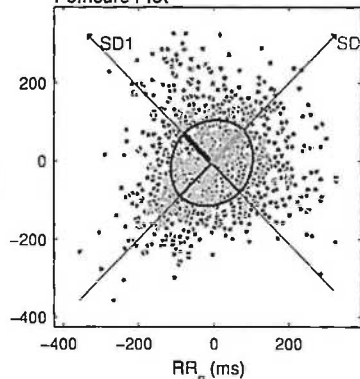


Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	1073	9.6	
LF (0.04-0.15 Hz)	0.0859	6281	56.2	62.2
HF (0.15-0.4 Hz)	0.2070	3817	34.2	37.8
Total		11171		
LF/HF		1.646		

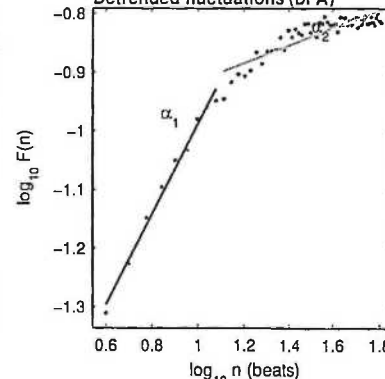
Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	105.1
SD2	(ms)	119.1
Recurrence plot		
Mean line length (Lmean)	(beats)	5.73
Max line length (Lmax)	(beats)	41
Recurrence rate (REC)	(%)	14.66
Determinism (DET)	(%)	93.34
Shannon Entropy (ShanEn)		2.434
Other		
Approximate entropy (ApEn)		1.637
Sample entropy (SampEn)		2.065
Detrended fluctuations (DFA): α1		0.770
Detrended fluctuations (DFA): α2		0.149
Correlation dimension (D2)		0.343
Multiscale entropy (MSE)		0.169 - 2.065

Poincare Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

HRV Analysis Results

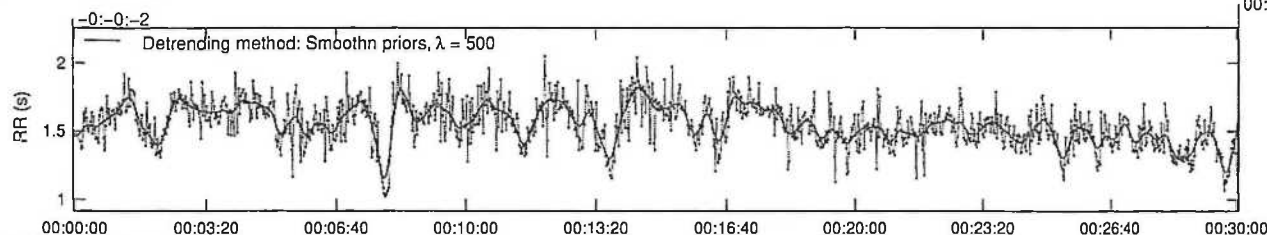
ABDULLAH HR data SLOW FEEDER day 2 week 4.txt - xx/xx/xx - xx:xx:xx

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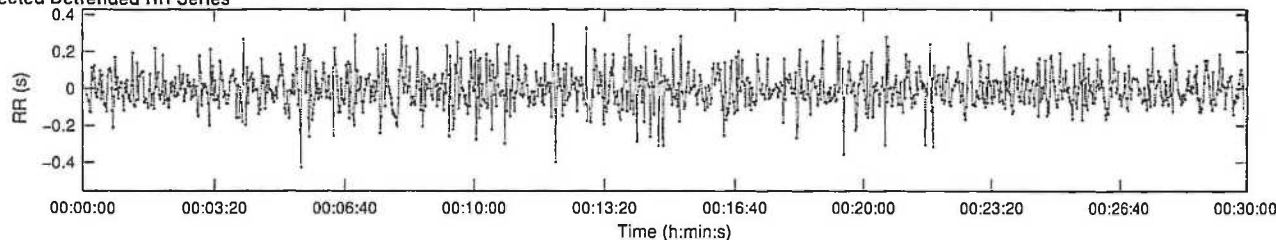
RR Interval Time Series

Results for a single sample

00:30:03



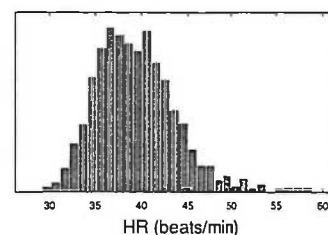
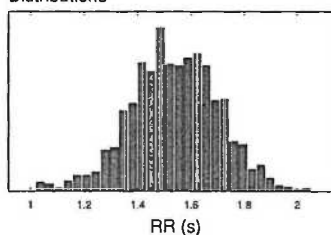
Selected Detrended RR Series



Time-Domain Results

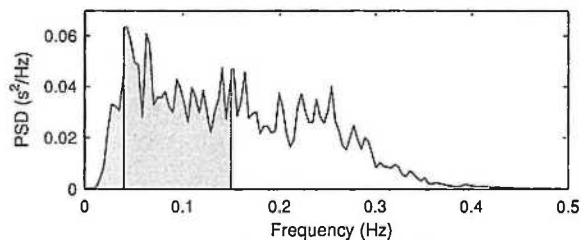
Variable	Units	Value
Mean RR*	(ms)	1537.4
STD RR (SDNN)	(ms)	101.8
Mean HR*	(1/min)	39.50
STD HR	(1/min)	3.84
RMSSD	(ms)	133.9
NN50	(count)	731
pNN50	(%)	61.1
RR triangular index		26.022
TINN	(ms)	610.0

Distributions*

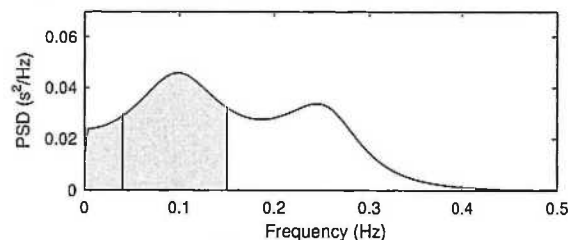


Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



AR Spectrum (AR model order = 16, not factorized)

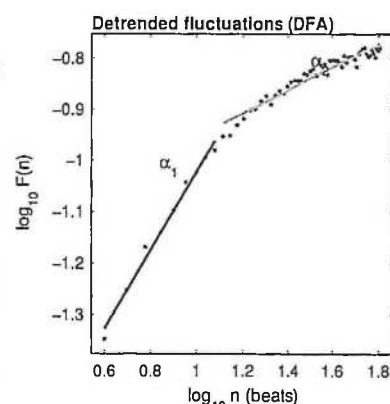
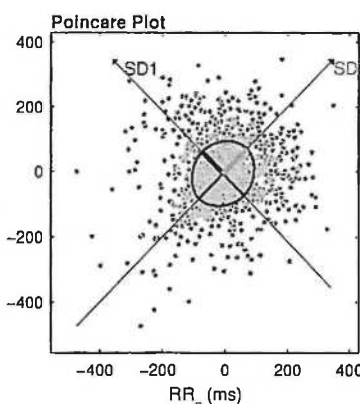


Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	646	6.9	
LF (0.04-0.15 Hz)	0.0430	4282	45.8	49.2
HF (0.15-0.4 Hz)	0.1523	4417	47.3	50.8
Total		9348		
LF/HF		0.969		

Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	994	9.9	
LF (0.04-0.15 Hz)	0.0977	4298	42.6	47.3
HF (0.15-0.4 Hz)	0.2461	4787	47.5	52.7
Total		10081		
LF/HF		0.898		

Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	94.7
SD2	(ms)	108.6
Recurrence plot		
Mean line length (Lmean)	(beats)	6.89
Max line length (Lmax)	(beats)	50
Recurrence rate (REC)	(%)	20.45
Determinism (DET)	(%)	95.77
Shannon Entropy (ShanEn)		2.677
Other		
Approximate entropy (ApEn)		1.539
Sample entropy (SampEn)		1.897
Detrended fluctuations (DFA): α_1		0.764
Detrended fluctuations (DFA): α_2		0.227
Correlation dimension (D2)		4.068
Multiscale entropy (MSE)		0.204 - 1.897



*Results are calculated from the non-detrended selected RR series.

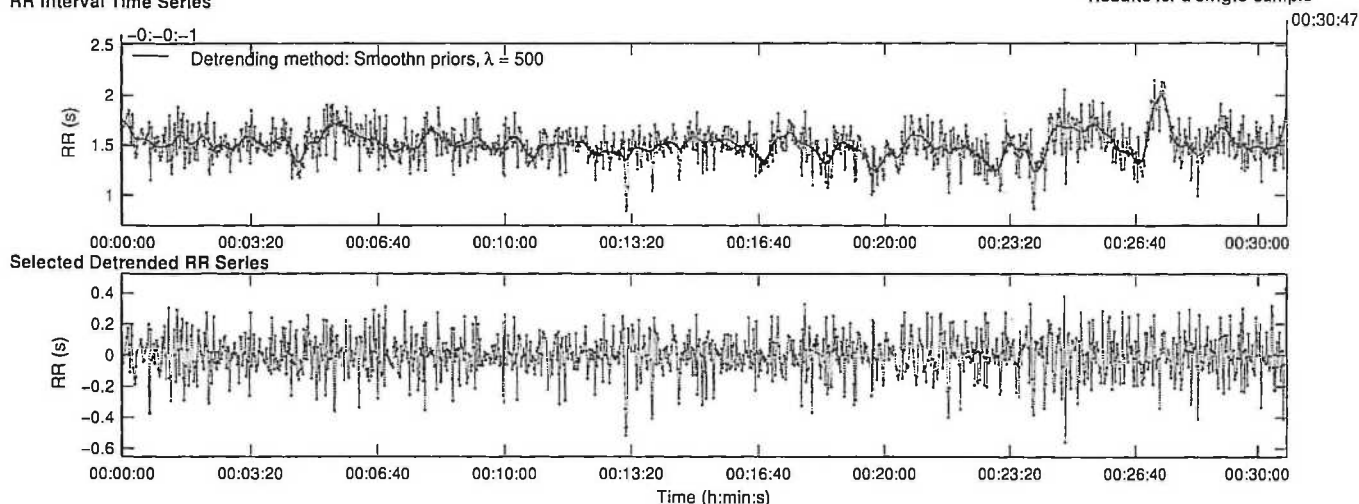
HRV Analysis Results

22 10 16 ABDULLAH SLOW FEEDER day 10 week 5.txt - xx/xx/xx - xx:xx:xx

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RR Interval Time Series

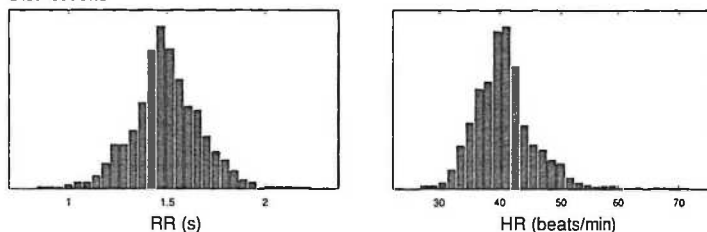
Results for a single sample



Time-Domain Results

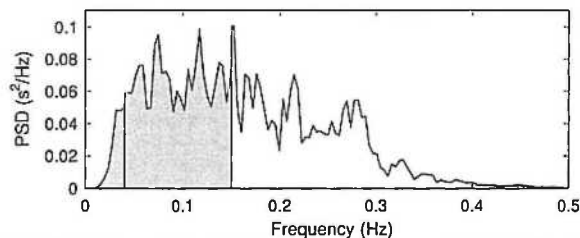
Variable	Units	Value
Mean RR*	(ms)	1494.2
STD RR (SDNN)	(ms)	132.8
Mean HR*	(1/min)	40.73
STD HR	(1/min)	4.67
RMSSD	(ms)	173.3
NN50	(count)	913
pNN50	(%)	70.7
RR triangular index		26.388
TINN	(ms)	725.0

Distributions*



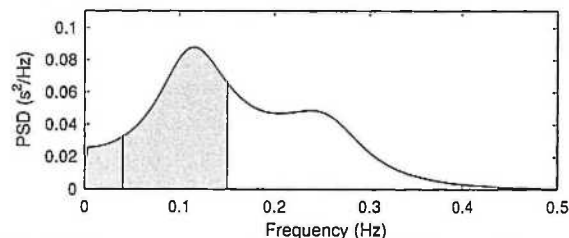
Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



Frequency Band	Peak (Hz)	Power (ms^2)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	710	4.5	
LF (0.04-0.15 Hz)	0.1172	7346	46.6	48.8
HF (0.15-0.4 Hz)	0.1523	7690	48.8	51.1
Total		15753		
LF/HF		0.955		

AR Spectrum (AR model order = 16, not factorized)

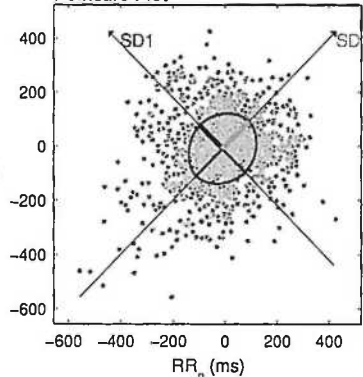


Frequency Band	Peak (Hz)	Power (ms^2)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	1081	6.7	
LF (0.04-0.15 Hz)	0.1133	7207	44.8	48.1
HF (0.15-0.4 Hz)	0.1523	7784	48.4	51.9
Total		16077		
LF/HF		0.926		

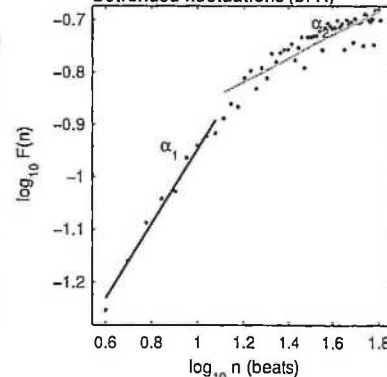
Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	122.6
SD2	(ms)	142.2
Recurrence plot		
Mean line length (Lmean)	(beats)	6.12
Max line length (Lmax)	(beats)	54
Recurrence rate (REC)	(%)	17.03
Determinism (DET)	(%)	94.28
Shannon Entropy (ShanEn)		2.522
Other		
Approximate entropy (ApEn)		1.545
Sample entropy (SampEn)		1.877
Detrended fluctuations (DFA): α_1		0.710
Detrended fluctuations (DFA): α_2		0.226
Correlation dimension (D2)		0.473
Multiscale entropy (MSE)		0.218 - 1.877

Poincare Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

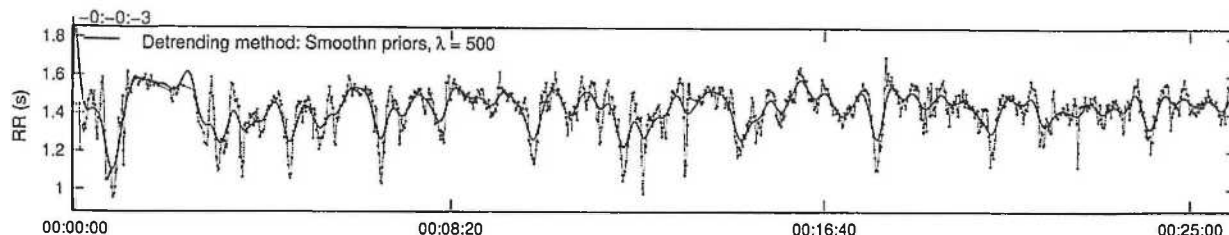
HRV Analysis Results

Balou Baseline HR data 1 14 09 16.txt - xx/xx/xx - xx:xx:xx

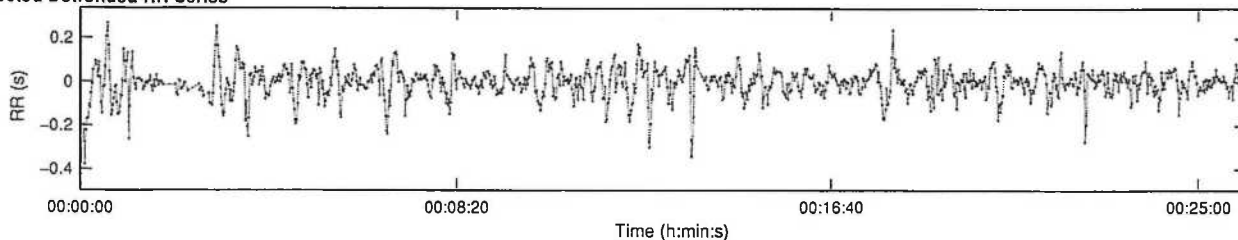
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RR Interval Time Series

Results for a single sample



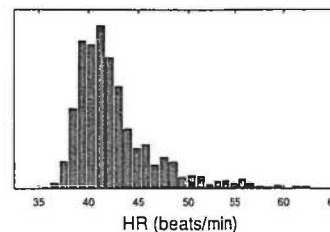
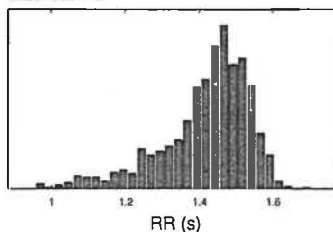
Selected Detrended RR Series



Time-Domain Results

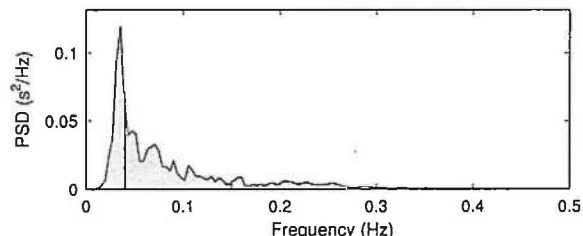
Variable	Units	Value
Mean RR*	(ms)	1418.3
STD RR (SDNN)	(ms)	71.3
Mean HR*	(1/min)	42.65
STD HR	(1/min)	3.76
RMSSD	(ms)	55.1
NN50	(count)	287
pNN50	(%)	26.6
RR triangular index		13.500
TINN	(ms)	490.0

Distributions*



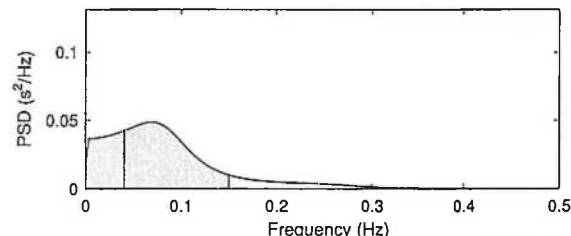
Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0352	1322	34.5	
LF (0.04-0.15 Hz)	0.0469	1947	50.8	77.6
HF (0.15-0.4 Hz)	0.1602	561	14.6	22.4
Total		3830		
LF/HF		3.473		

AR Spectrum (AR model order = 16, not factorized)

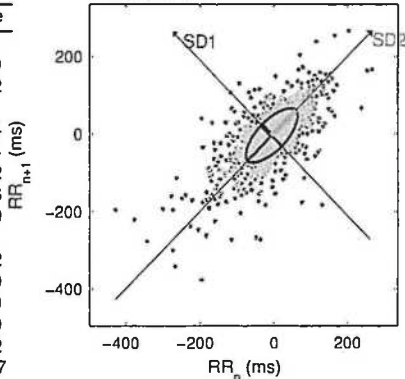


Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	1501	25.4	
LF (0.04-0.15 Hz)	0.0703	3675	62.3	83.6
HF (0.15-0.4 Hz)	0.1523	720	12.2	16.4
Total		5897		
LF/HF		5.104		

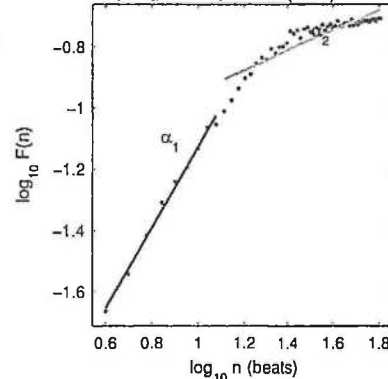
Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	39.0
SD2	(ms)	92.2
Recurrence plot		
Mean line length (Lmean)	(beats)	14.24
Max line length (Lmax)	(beats)	184
Recurrence rate (REC)	(%)	40.62
Determinism (DET)	(%)	98.96
Shannon Entropy (ShanEn)		3.509
Other		
Approximate entropy (ApEn)		1.382
Sample entropy (SampEn)		1.430
Detrended fluctuations (DFA): α1		1.320
Detrended fluctuations (DFA): α2		0.330
Correlation dimension (D2)		3.732
Multiscale entropy (MSE)		0.481 - 1.567

Poincare Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

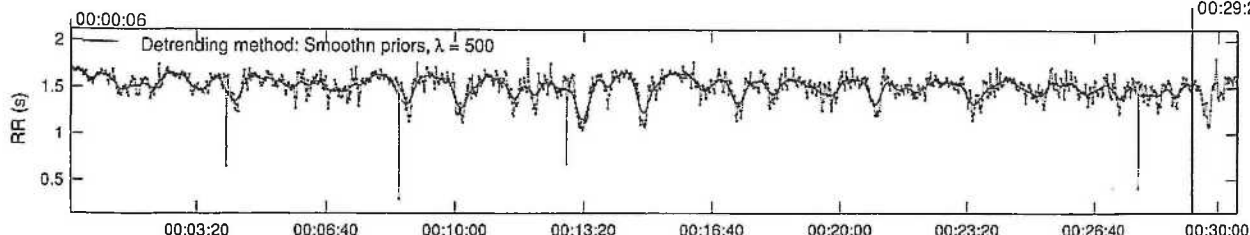
HRV Analysis Results

Balou baseline data 2 15 9 REPAIRED.txt - xx/xx/xx - xx:xx:xx

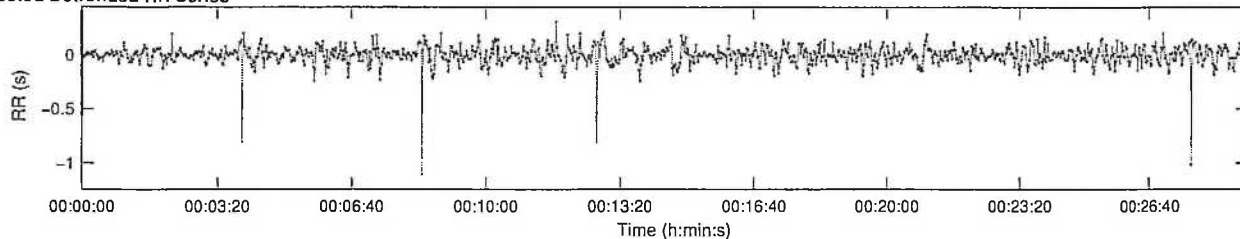
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RR Interval Time Series

Results for a single sample



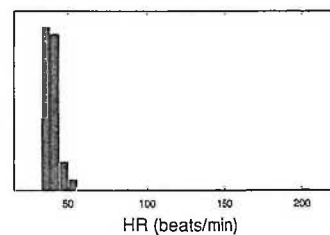
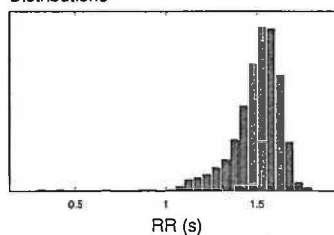
Selected Detrended RR Series



Time-Domain Results

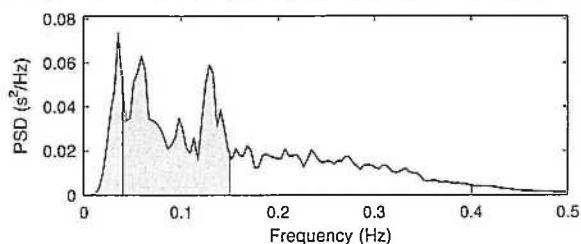
Variable	Units	Value
Mean RR*	(ms)	1499.9
STD RR (SDNN)	(ms)	94.2
Mean HR*	(1/min)	40.56
STD HR	(1/min)	7.04
RMSSD	(ms)	107.0
NN50	(count)	508
pNN50	(%)	43.5
RR triangular index		16.222
TINN	(ms)	960.0

Distributions*



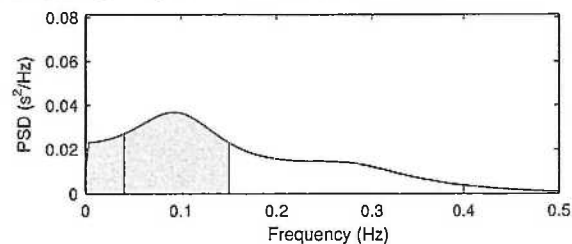
Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0352	918	11.3	
LF (0.04-0.15 Hz)	0.0586	3907	48.2	54.4
HF (0.15-0.4 Hz)	0.1680	3273	40.4	45.5
Total		8106		
LF/HF		1.194		

AR Spectrum (AR model order = 16, not factorized)

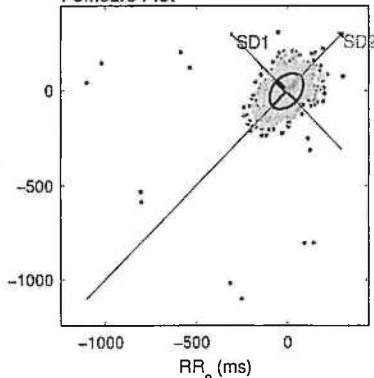


Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	955	12.6	
LF (0.04-0.15 Hz)	0.0938	3511	46.4	53.0
HF (0.15-0.4 Hz)	0.1523	3101	40.9	46.8
Total		7575		
LF/HF		1.132		

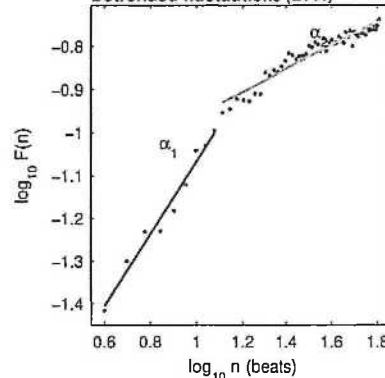
Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	75.7
SD2	(ms)	109.7
Recurrence plot		
Mean line length (Lmean)	(beats)	12.95
Max line length (Lmax)	(beats)	91.5
Recurrence rate (REC)	(%)	45.27
Determinism (DET)	(%)	98.36
Shannon Entropy (ShanEn)		3.393
Other		
Approximate entropy (ApEn)		1.462
Sample entropy (SampEn)		1.481
Detrended fluctuations (DFA): α1		0.849
Detrended fluctuations (DFA): α2		0.273
Correlation dimension (D2)		4.330
Multiscale entropy (MSE)		0.249 - 1.512

Poincare Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

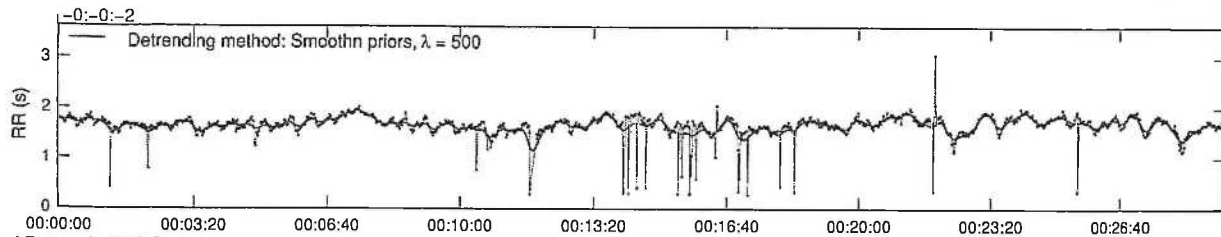
HRV Analysis Results

Balou Baseline HR data 3 210916.txt - xx/xx/xx - xx:xx:xx

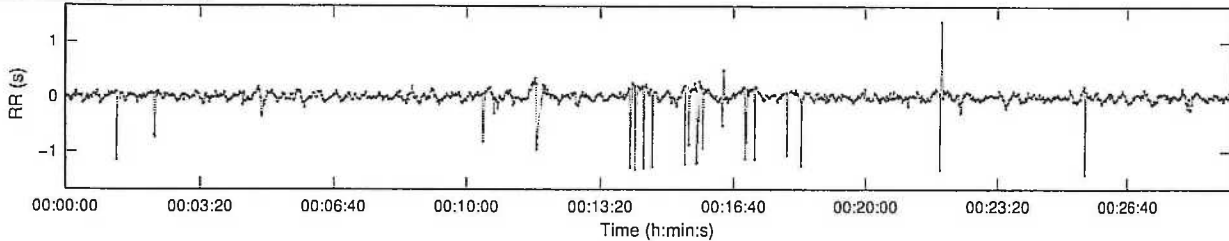
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RR Interval Time Series

Results for a single sample



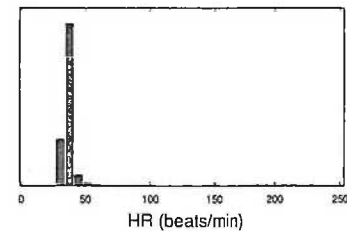
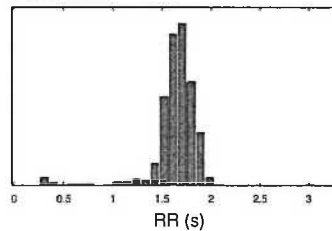
Selected Detrended RR Series



Time-Domain Results

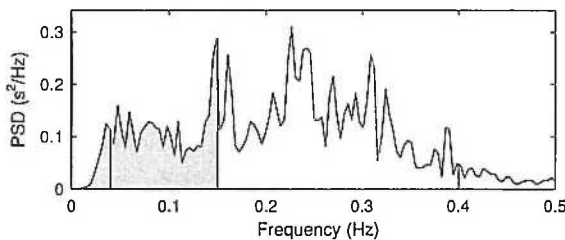
Variable	Units	Value
Mean RR*	(ms)	1637.2
STD RR (SDNN)	(ms)	195.6
Mean HR*	(1/min)	39.32
STD HR	(1/min)	20.24
RMSSD	(ms)	235.0
NN50	(count)	374
pNN50	(%)	35.0
RR triangular index		16.227
TINN	(ms)	1875.0

Distributions*



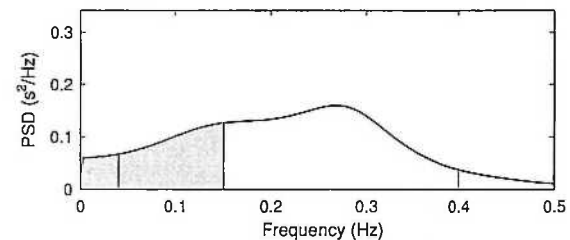
Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0352	1517	3.2	
LF (0.04-0.15 Hz)	0.1484	12503	26.6	27.5
HF (0.15-0.4 Hz)	0.2266	32946	70.0	72.3
Total		47058		
LF/HF		0.380		

AR Spectrum (AR model order = 16, not factorized)

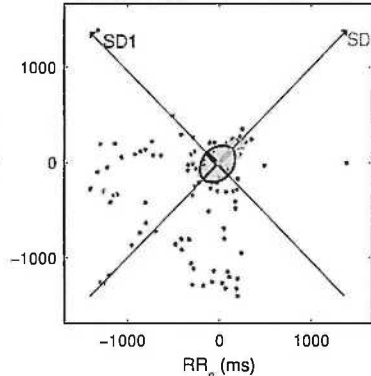


Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	2438	5.7	
LF (0.04-0.15 Hz)	0.1484	10718	25.2	26.7
HF (0.15-0.4 Hz)	0.2695	29292	68.9	73.1
Total		42524		
LF/HF		0.366		

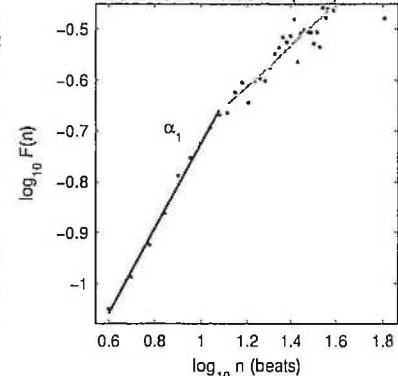
Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	166.2
SD2	(ms)	221.3
Recurrence plot		
Mean line length (Lmean)	(beats)	30.98
Max line length (Lmax)	(beats)	285
Recurrence rate (REC)	(%)	66.41
Determinism (DET)	(%)	99.94
Shannon Entropy (ShanEn)		3.896
Other		
Approximate entropy (ApEn)		0.885
Sample entropy (SampEn)		0.779
Detrended fluctuations (DFA): α1		0.835
Detrended fluctuations (DFA): α2		0.402
Correlation dimension (D2)		4.608
Multiscale entropy (MSE)		0.314 - 0.779

Poincare Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

HRV Analysis Results

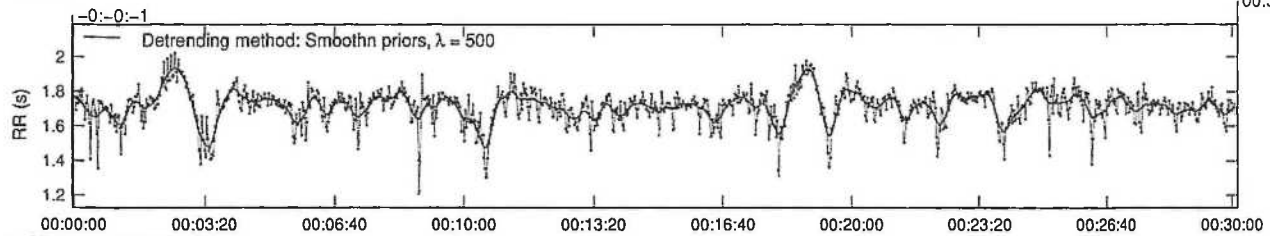
HR data day 2 week 1 BALOU loose hay.txt - xx/xx/xx - xx:xx:xx

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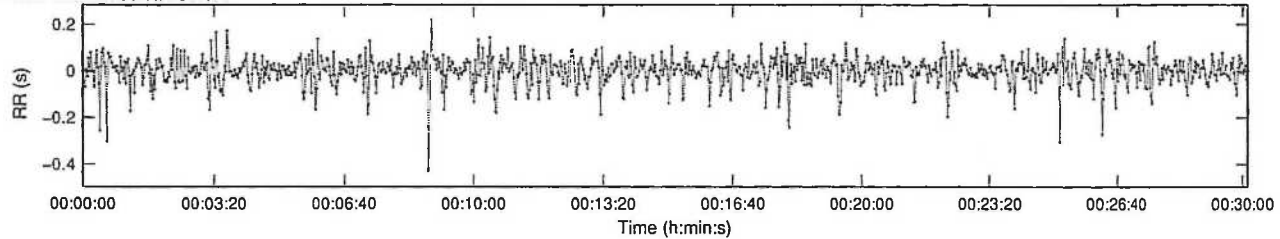
RR Interval Time Series

Results for a single sample

00:30:09



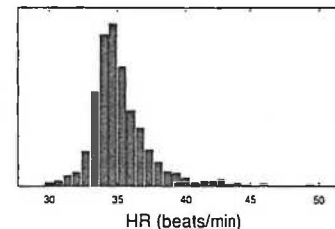
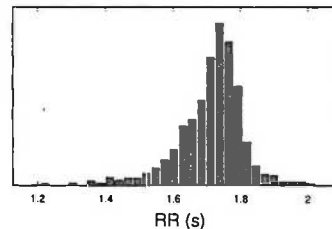
Selected Detrended RR Series



Time-Domain Results

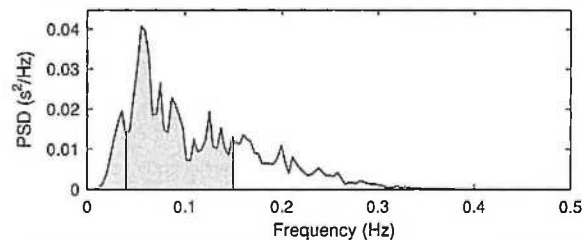
Variable	Units	Value
Mean RR*	(ms)	1709.4
STD RR (SDNN)	(ms)	61.4
Mean HR*	(1/min)	35.23
STD HR	(1/min)	2.15
RMSSD	(ms)	71.5
NN50	(count)	403
pNN50	(%)	38.1
RR triangular index		13.766
TINN	(ms)	455.0

Distributions*

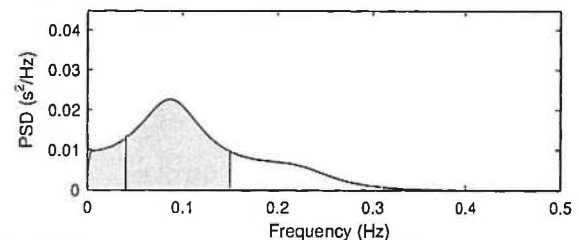


Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



AR Spectrum (AR model order = 16, not factorized)



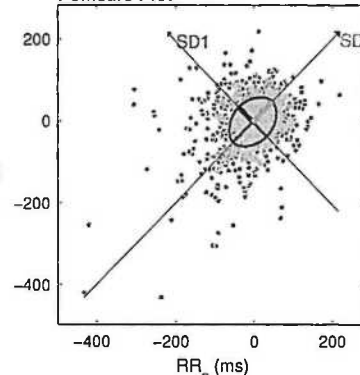
Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0352	287	9.2	
LF (0.04-0.15 Hz)	0.0547	1960	63.1	69.5
HF (0.15-0.4 Hz)	0.1602	860	27.7	30.5
Total		3107		
LF/HF		2.279		

Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	417	13.4	
LF (0.04-0.15 Hz)	0.0859	1870	60.0	69.2
HF (0.15-0.4 Hz)	0.1523	831	26.6	30.8
Total		3118		
LF/HF		2.251		

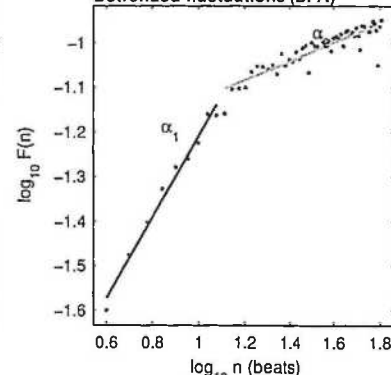
Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	50.6
SD2	(ms)	70.7
Recurrence plot		
Mean line length (Lmean)	(beats)	9.15
Max line length (Lmax)	(beats)	65
Recurrence rate (REC)	(%)	31.27
Determinism (DET)	(%)	97.12
Shannon Entropy (ShanEn)		3.014
Other		
Approximate entropy (ApEn)		1.526
Sample entropy (SampEn)		1.739
Detrended fluctuations (DFA): α1		0.908
Detrended fluctuations (DFA): α2		0.210
Correlation dimension (D2)		4.290
Multiscale entropy (MSE)		0.170 - 1.739

Poincare Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

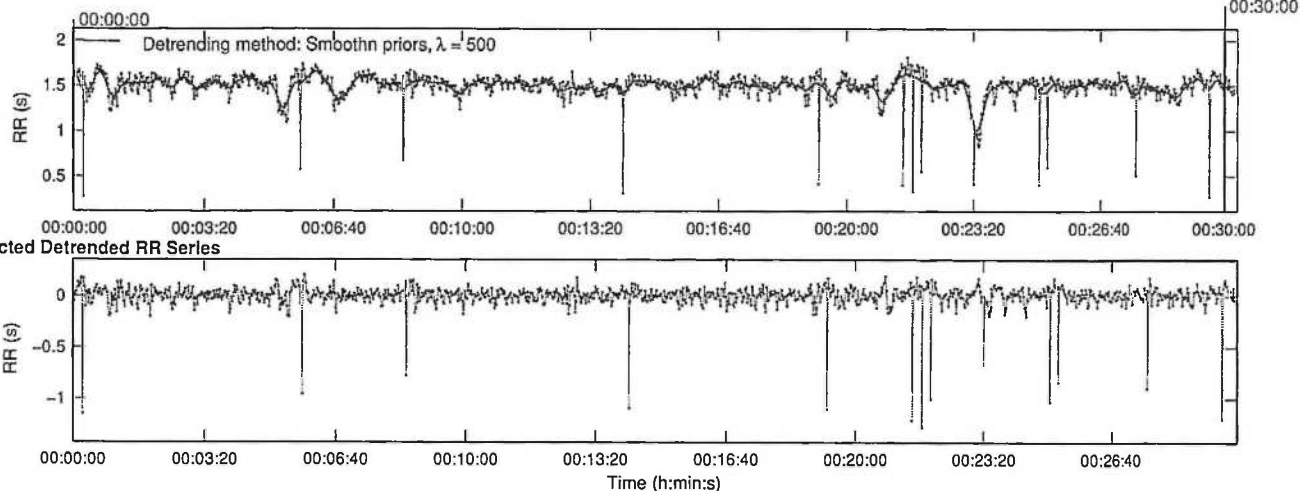
HRV Analysis Results

BALOU HR DATA week 2 DAY 10 30 09 16.txt - xx/xx/xx - xx:xx:xx

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RR Interval Time Series

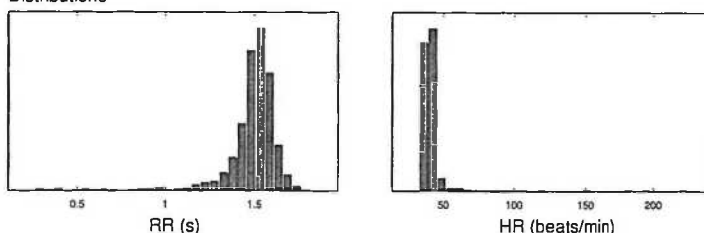
Results for a single sample



Time-Domain Results

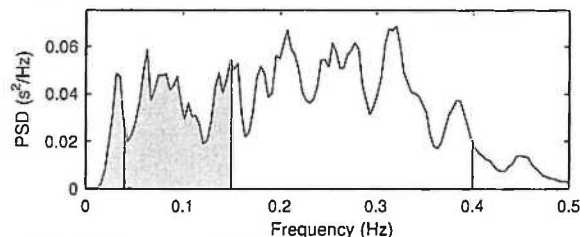
Variable	Units	Value
Mean RR*	(ms)	1484.9
STD RR (SDNN)	(ms)	134.2
Mean HR*	(1/min)	41.64
STD HR	(1/min)	12.68
RMSSD	(ms)	158.4
NN50	(count)	557
pNN50	(%)	46.0
RR triangular index		15.551
TINN	(ms)	1015.0

Distributions*



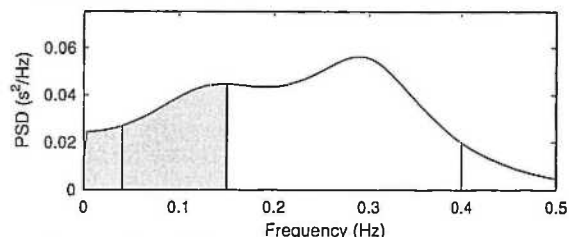
Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



Frequency Band	Peak (Hz)	Power (ms ²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0313	694	4.4	
LF (0.04-0.15 Hz)	0.0625	4162	26.2	27.4
HF (0.15-0.4 Hz)	0.3203	11006	69.2	72.4
Total		15900		
LF/HF		0.378		

AR Spectrum (AR model order = 16, not factorized)

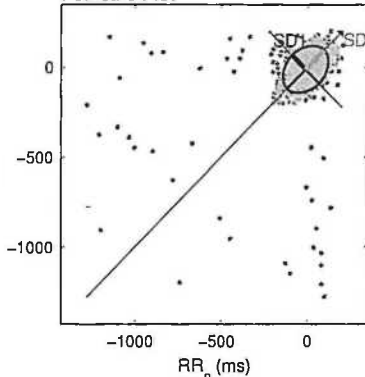


Frequency Band	Peak (Hz)	Power (ms ²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	984	6.1	
LF (0.04-0.15 Hz)	0.1484	4099	25.4	27.1
HF (0.15-0.4 Hz)	0.2891	10987	68.2	72.6
Total		16110		
LF/HF		0.373		

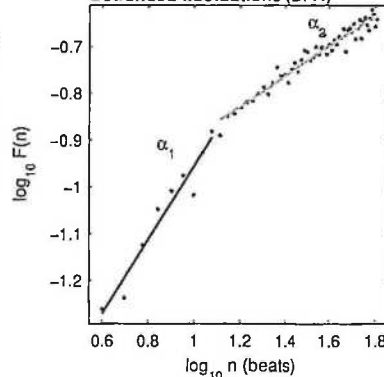
Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	112.1
SD2	(ms)	153.3
Recurrence plot		
Mean line length (Lmean)	(beats)	36.25
Max line length (Lmax)	(beats)	209
Recurrence rate (REC)	(%)	73.88
Determinism (DET)	(%)	99.54
Shannon Entropy (ShanEn)		4.370
Other		
Approximate entropy (ApEn)		1.362
Sample entropy (SampEn)		1.290
Detrended fluctuations (DFA): α_1		0.789
Detrended fluctuations (DFA): α_2		0.325
Correlation dimension (D2)		5.021
Multiscale entropy (MSE)		0.223 - 1.290

Poincare Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

HRV Analysis Results

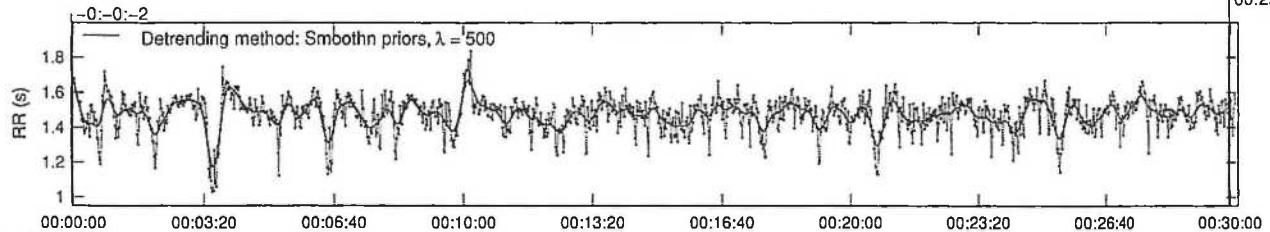
BALOU HR data 3 day 21 loose hay.txt - xx/xx/xx - xx:xx:xx

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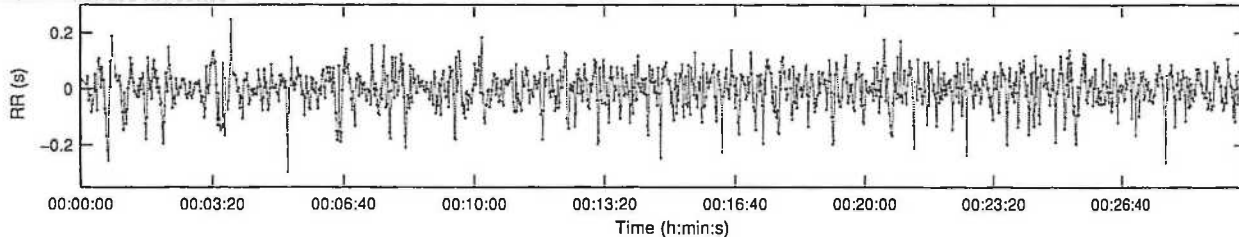
RR Interval Time Series

Results for a single sample

00:29:58



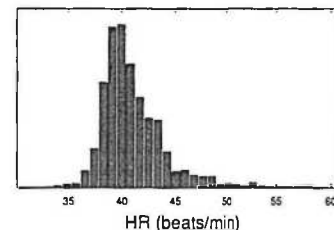
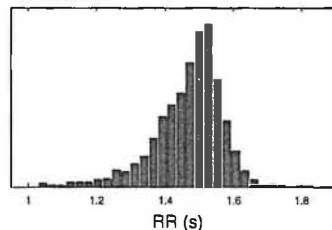
Selected Detrended RR Series



Time-Domain Results

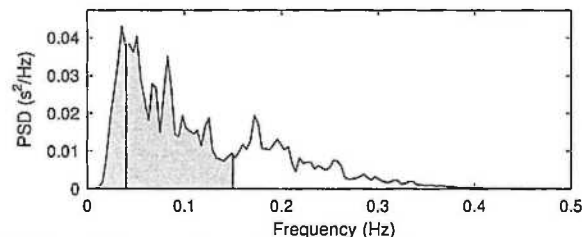
Variable	Units	Value
Mean RR*	(ms)	1468.8
STD RR (SDNN)	(ms)	67.5
Mean HR*	(1/min)	41.07
STD HR	(1/min)	3.03
RMSSD	(ms)	75.6
NN50	(count)	545
pNN50	(%)	44.7
RR triangular index		17.941
TINN	(ms)	410.0

Distributions*



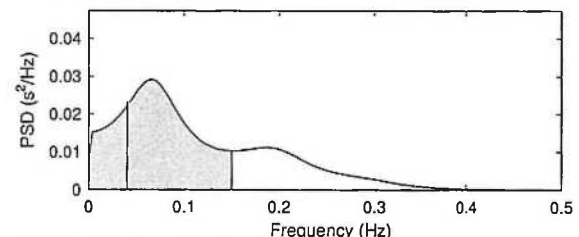
Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0352	628	15.5	
LF (0.04-0.15 Hz)	0.0508	2180	53.6	63.4
HF (0.15-0.4 Hz)	0.1719	1258	30.9	36.6
Total		4066		
LF/HF		1.733		

AR Spectrum (AR model order = 16, not factorized)

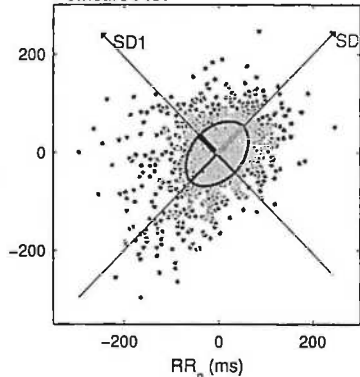


Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	682	16.9	
LF (0.04-0.15 Hz)	0.0664	2139	52.9	63.6
HF (0.15-0.4 Hz)	0.1875	1225	30.3	36.4
Total		4047		
LF/HF		1.746		

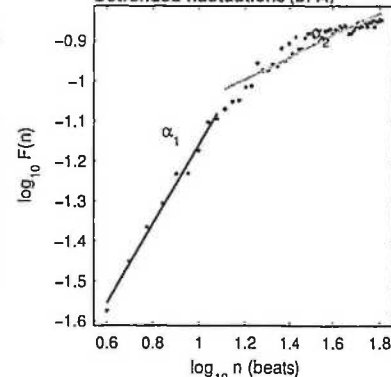
Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	53.5
SD2	(ms)	79.0
Recurrence plot		
Mean line length (Lmean)	(beats)	7.22
Max line length (Lmax)	(beats)	47
Recurrence rate (REC)	(%)	21.72
Determinism (DET)	(%)	95.73
Shannon Entropy (ShanEn)		2.732
Other		
Approximate entropy (ApEn)		1.584
Sample entropy (SampEn)		1.906
Detrended fluctuations (DFA): α1		0.990
Detrended fluctuations (DFA): α2		0.274
Correlation dimension (D2)		4.674
Multiscale entropy (MSE)		0.282 - 1.906

Poincare Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

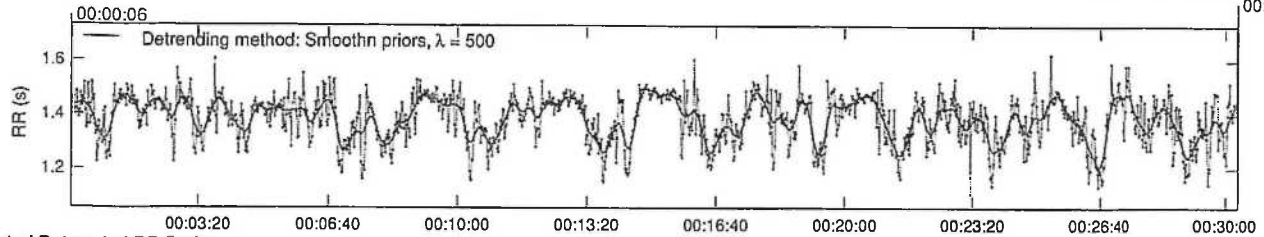
HRV Analysis Results

BALOU HR data week 4 day 2 HAYNET EDIT.txt - xx/xx/xx - xx:xx:xx

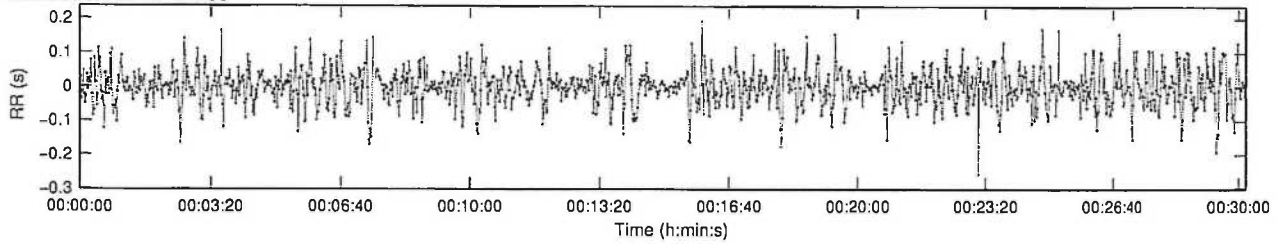
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RR Interval Time Series

Results for a single sample



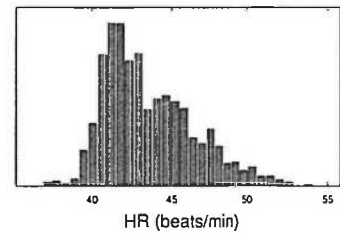
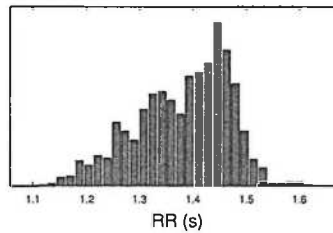
Selected Detrended RR Series



Time-Domain Results

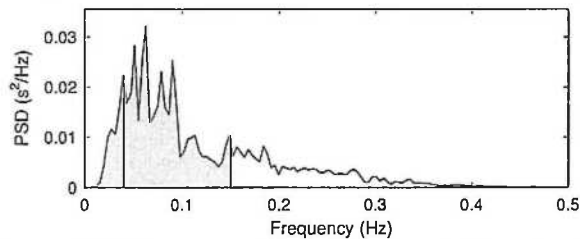
Variable	Units	Value
Mean RR*	(ms)	1381.4
STD RR (SDNN)	(ms)	53.7
Mean HR*	(1/min)	43.62
STD HR	(1/min)	2.56
RMSSD	(ms)	57.1
NN50	(count)	409
pNN50	(%)	31.2
RR triangular index		11.945
TINN	(ms)	320.0

Distributions*



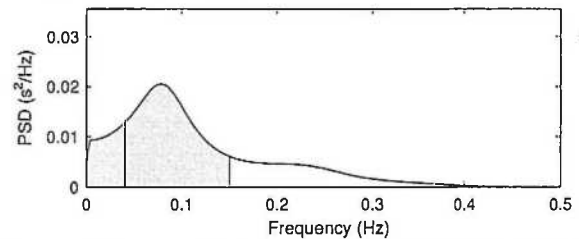
Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	274	11.2	
LF (0.04-0.15 Hz)	0.0625	1485	60.7	68.4
HF (0.15-0.4 Hz)	0.1836	687	28.1	31.6
Total		2447		
LF/HF		2.161		

AR Spectrum (AR model order = 16, not factorized)

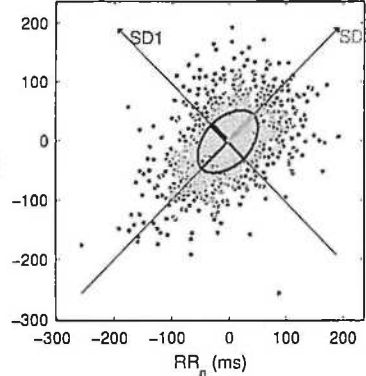


Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	406	15.3	
LF (0.04-0.15 Hz)	0.0781	1562	59.0	69.6
HF (0.15-0.4 Hz)	0.1523	681	25.7	30.4
Total		2649		
LF/HF		2.293		

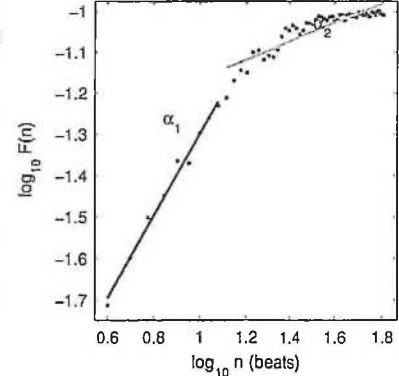
Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	40.4
SD2	(ms)	64.3
Recurrence plot		
Mean line length (Lmean)	(beats)	8.94
Max line length (Lmax)	(beats)	59
Recurrence rate (REC)	(%)	25.13
Determinism (DET)	(%)	96.58
Shannon Entropy (ShanEn)		2.974
Other		
Approximate entropy (ApEn)		1.491
Sample entropy (SampEn)		1.645
Detrended fluctuations (DFA): α1		0.993
Detrended fluctuations (DFA): α2		0.228
Correlation dimension (D2)		3.951
Multiscale entropy (MSE)		0.215 - 1.645

Poincare Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

HRV Analysis Results

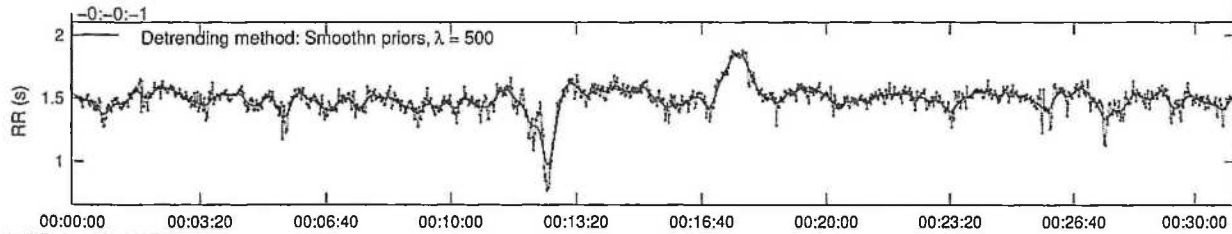
BALOU haynet data week 5 day 10 22 10 16.txt - xx/xx/xx - xx:xx:xx

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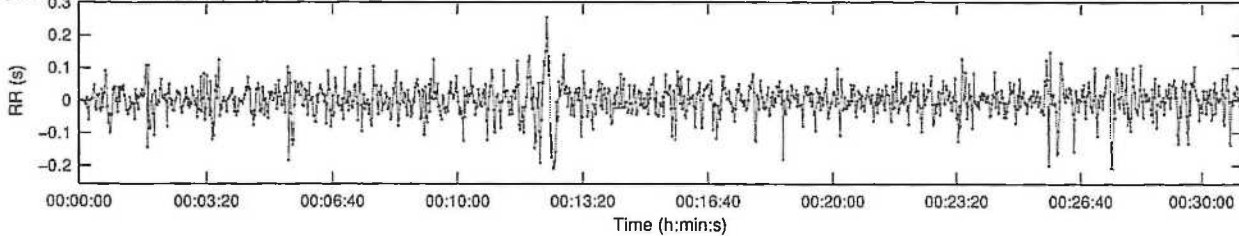
RR Interval Time Series

Results for a single sample

00:31:07



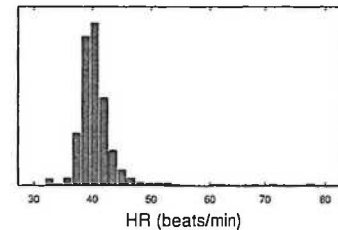
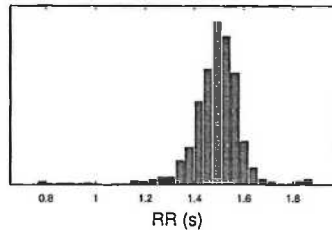
Selected Detrended RR Series



Time-Domain Results

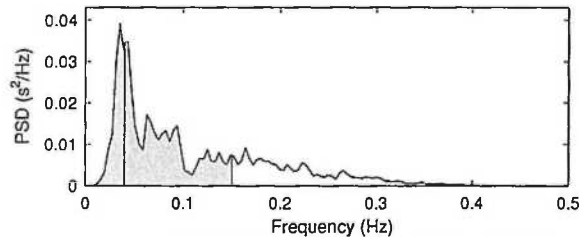
Variable	Units	Value
Mean RR*	(ms)	1485.4
STD RR (SDNN)	(ms)	50.3
Mean HR*	(1/min)	40.70
STD HR	(1/min)	3.28
RMSSD	(ms)	53.9
NN50	(count)	362
pNN50	(%)	28.9
RR triangular index		11.620
TINN	(ms)	335.0

Distributions*



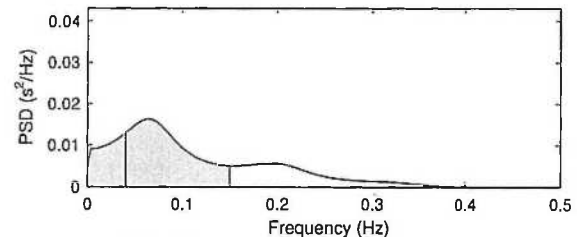
Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0352	471	20.4	
LF (0.04-0.15 Hz)	0.0430	1180	51.2	64.3
HF (0.15-0.4 Hz)	0.1641	653	28.4	35.6
Total		2304		
LF/HF		1.805		

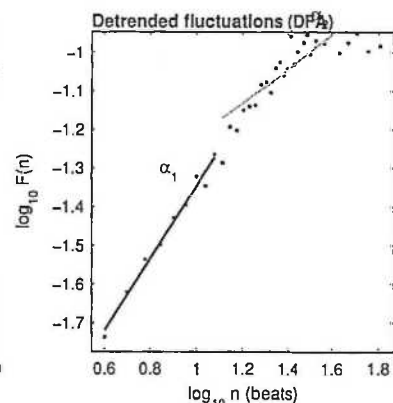
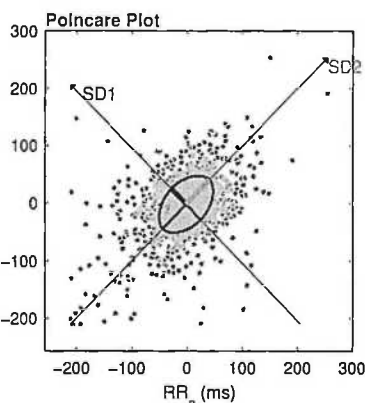
AR Spectrum (AR model order = 16, not factorized)



Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	401	18.4	
LF (0.04-0.15 Hz)	0.0625	1164	53.2	65.2
HF (0.15-0.4 Hz)	0.1953	620	28.4	34.8
Total		2186		
LF/HF		1.876		

Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	38.1
SD2	(ms)	60.2
Recurrence plot		
Mean line length (Lmean)	(beats)	9.31
Max line length (Lmax)	(beats)	72
Recurrence rate (REC)	(%)	33.33
Determinism (DET)	(%)	97.30
Shannon Entropy (ShanEn)		3.040
Other		
Approximate entropy (ApEn)		1.513
Sample entropy (SampEn)		1.812
Detrended fluctuations (DFA): α1		0.936
Detrended fluctuations (DFA): α2		0.439
Correlation dimension (D2)		2.839
Multiscale entropy (MSE)		0.168 - 1.820



*Results are calculated from the non-detrended selected RR series.

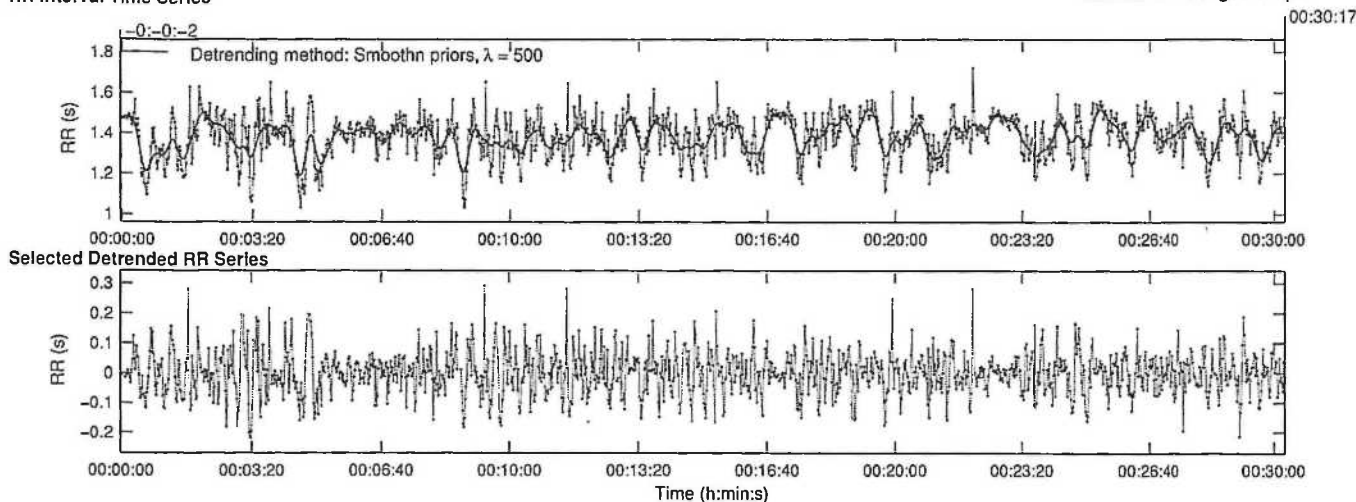
HRV Analysis Results

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RR Interval Time Series

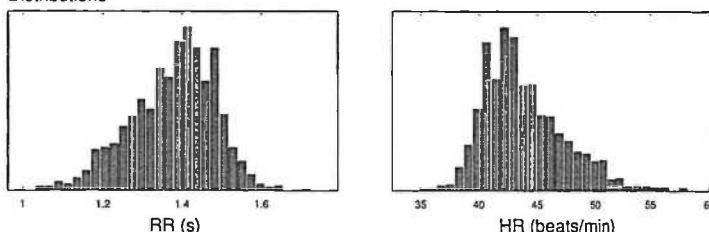
Results for a single sample



Time-Domain Results

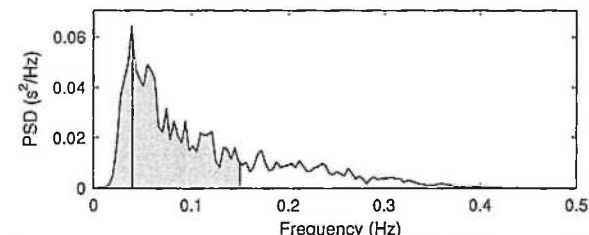
Variable	Units	Value
Mean RR*	(ms)	1376.9
STD RR (SDNN)	(ms)	72.0
Mean HR*	(1/min)	43.84
STD HR	(1/min)	3.31
RMSSD	(ms)	75.7
NN50	(count)	564
pNN50	(%)	42.9
RR triangular index		17.303
TINN	(ms)	385.0

Distributions*



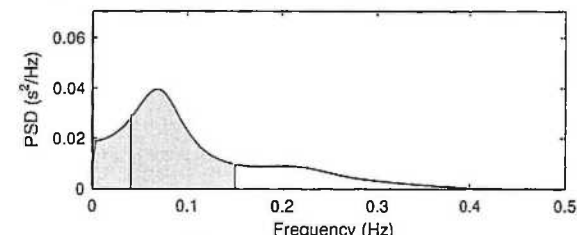
Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	779	16.4	
LF (0.04-0.15 Hz)	0.0547	2712	57.1	68.3
HF (0.15-0.4 Hz)	0.1719	1259	26.5	31.7
Total		4751		
LF/HF		2.153		

AR Spectrum (AR model order = 16, not factorized)

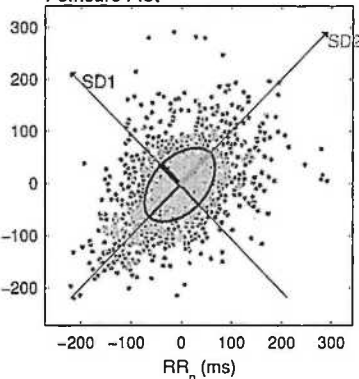


Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	847	17.7	
LF (0.04-0.15 Hz)	0.0664	2729	56.9	69.1
HF (0.15-0.4 Hz)	0.1523	1219	25.4	30.9
Total		4796		
LF/HF		2.239		

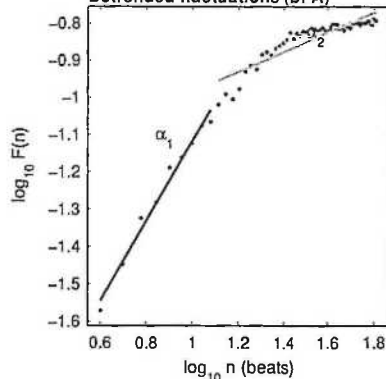
Nonlinear Results

Variable	Units	Value
Poincaré plot		
SD1	(ms)	53.5
SD2	(ms)	86.6
Recurrence plot		
Mean line length (Lmean)	(beats)	7.58
Max line length (Lmax)	(beats)	89
Recurrence rate (REC)	(%)	21.86
Determinism (DET)	(%)	96.01
Shannon Entropy (ShanEn)		2.778
Other		
Approximate entropy (ApEn)		1.545
Sample entropy (SampEn)		1.824
Detrended fluctuations (DFA): α_1		1.069
Detrended fluctuations (DFA): α_2		0.267
Correlation dimension (D2)		4.521
Multiscale entropy (MSE)		0.357 - 1.824

Poincaré Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

HRV Analysis Results

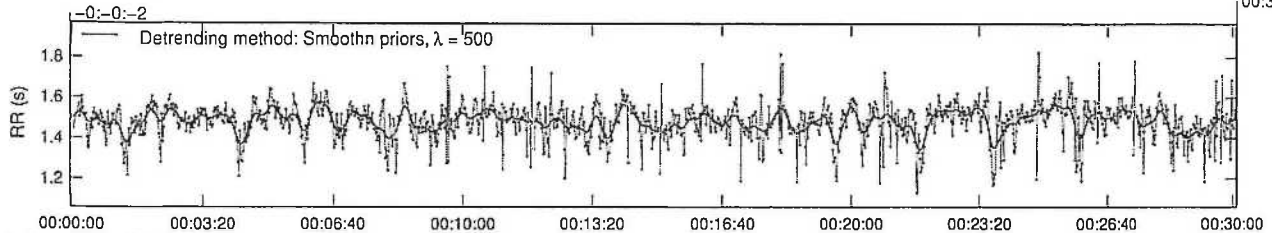
BALOU SLOW FEEDER 03 11 16.txt - xx/xx/xx - xx:xx:xx

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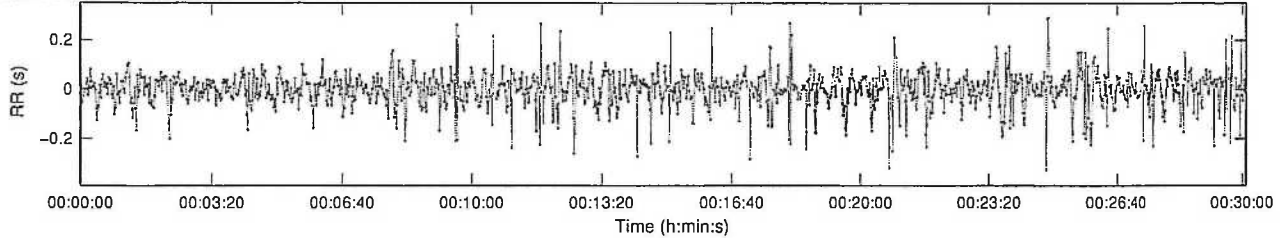
RR Interval Time Series

Results for a single sample

00:30:06



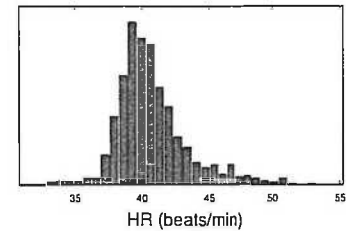
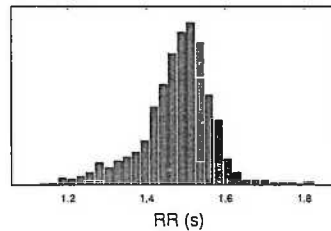
Selected Detrended RR Series



Time-Domain Results

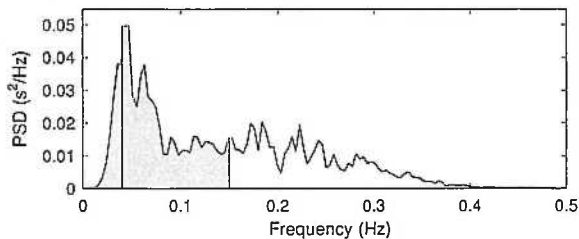
Variable	Units	Value
Mean RR*	(ms)	1478.3
STD RR (SDNN)	(ms)	74.5
Mean HR*	(1/min)	40.76
STD HR	(1/min)	2.61
RMSSD	(ms)	95.8
NN50	(count)	513
pNN50	(%)	41.6
RR triangular index		14.034
TINN	(ms)	445.0

Distributions*



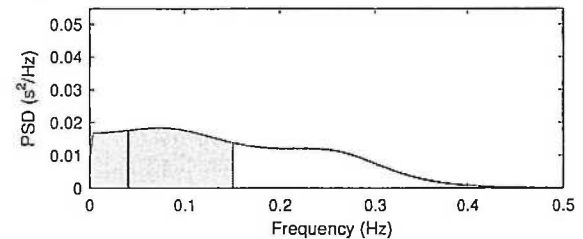
Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0352	487	10.5	
LF (0.04-0.15 Hz)	0.0469	2190	47.1	52.6
HF (0.15-0.4 Hz)	0.1836	1972	42.4	47.4
Total		4650		
LF/HF		1.110		

AR Spectrum (AR model order = 16, not factorized)

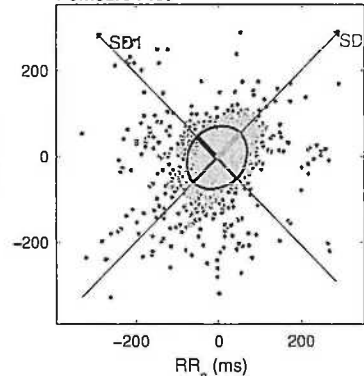


Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	665	14.5	
LF (0.04-0.15 Hz)	0.0742	1868	40.8	47.7
HF (0.15-0.4 Hz)	0.1523	2047	44.7	52.3
Total		4581		
LF/HF		0.912		

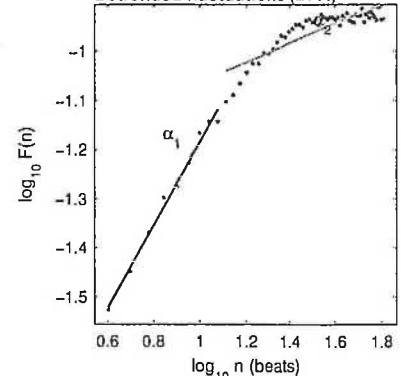
Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	67.8
SD2	(ms)	80.7
Recurrence plot		
Mean line length (Lmean)	(beats)	8.59
Max line length (Lmax)	(beats)	111
Recurrence rate (REC)	(%)	29.96
Determinism (DET)	(%)	97.62
Shannon Entropy (ShanEn)		2.936
Other		
Approximate entropy (ApEn)		1.533
Sample entropy (SampEn)		1.797
Detrended fluctuations (DFA): α_1		0.845
Detrended fluctuations (DFA): α_2		0.198
Correlation dimension (D2)		4.752
Multiscale entropy (MSE)		0.124 - 1.797

Poincare Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

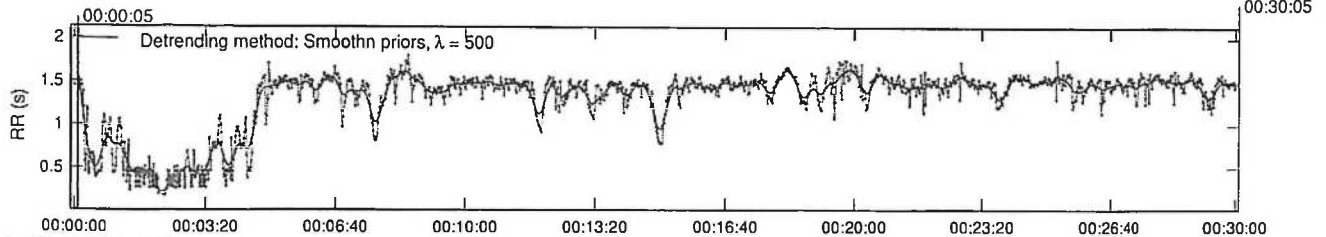
HRV Analysis Results

Balou slow feeder day 10 11 11 16.txt – xx/xx/xx – xx:xx:xx

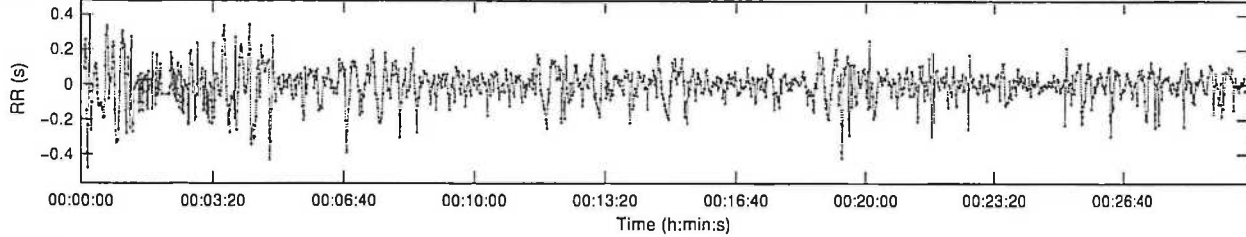
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RR Interval Time Series

Results for a single sample



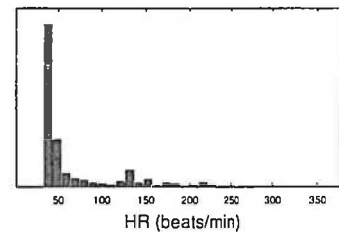
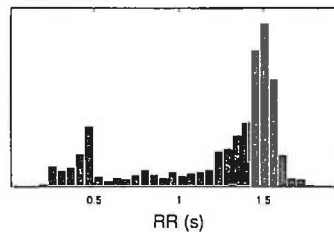
Selected Detrended RR Series



Time-Domain Results

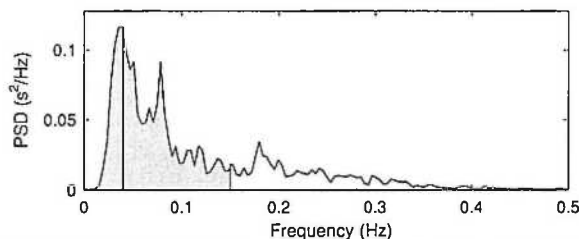
Variable	Units	Value
Mean RR*	(ms)	1206.8
STD RR (SDNN)	(ms)	107.6
Mean HR*	(1/min)	64.53
STD HR	(1/min)	20.27
RMSSD	(ms)	91.0
NN50	(count)	680
pNN50	(%)	46.0
RR triangular index		22.075
TINN	(ms)	635.0

Distributions*



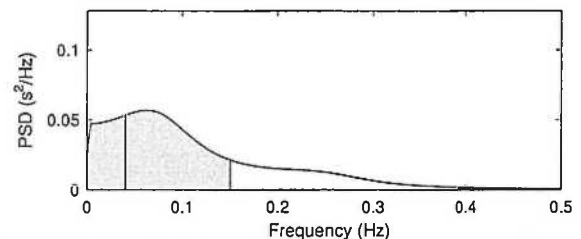
Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0–0.04 Hz)	0.0391	1705	20.1	
LF (0.04–0.15 Hz)	0.0430	4472	52.7	66.0
HF (0.15–0.4 Hz)	0.1797	2299	27.1	33.9
Total		8478		
LF/HF		1.945		

AR Spectrum (AR model order = 16, not factorized)

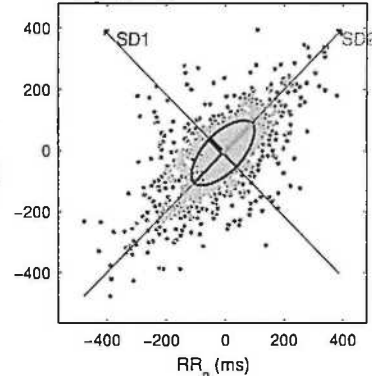


Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0–0.04 Hz)	0.0391	1919	21.3	
LF (0.04–0.15 Hz)	0.0625	4712	52.4	66.6
HF (0.15–0.4 Hz)	0.1523	2356	26.2	33.3
Total		8990		
LF/HF		2.000		

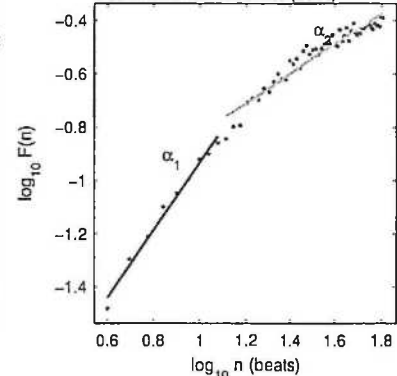
Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	64.4
SD2	(ms)	138.0
Recurrence plot		
Mean line length (Lmean)	(beats)	13.75
Max line length (Lmax)	(beats)	196
Recurrence rate (REC)	(%)	38.27
Determinism (DET)	(%)	98.70
Shannon Entropy (ShanEn)		3.423
Other		
Approximate entropy (ApEn)		1.346
Sample entropy (SampEn)		1.426
Detrended fluctuations (DFA): α1		1.268
Detrended fluctuations (DFA): α2		0.557
Correlation dimension (D2)		4.575
Multiscale entropy (MSE)		0.446 – 1.455

Poincare Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

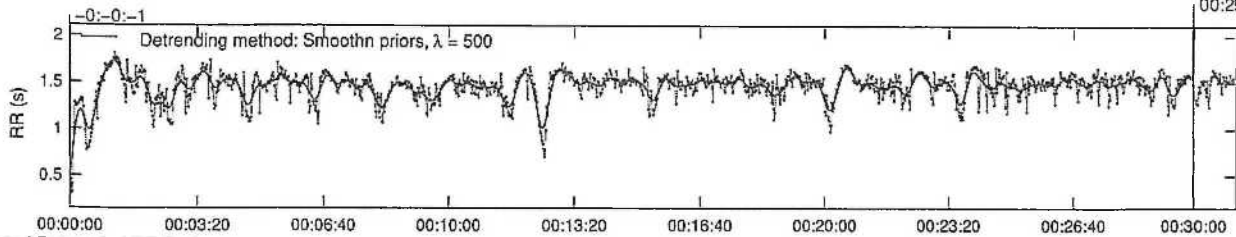
HRV Analysis Results

BALOU SLOW FEEDER 21 11 16 END.txt - xx/xx/xx - xx:xx:xx

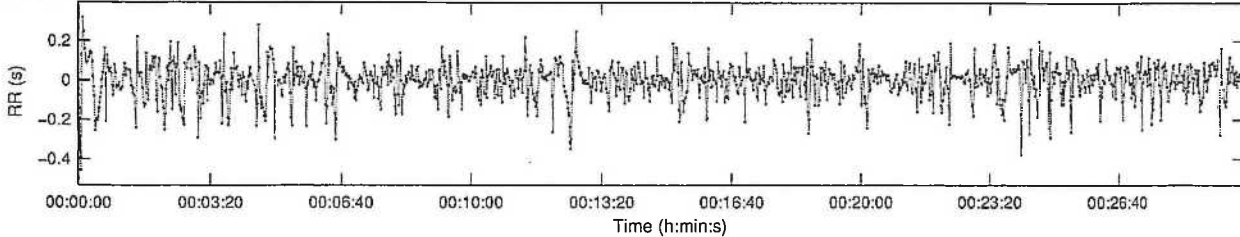
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RR Interval Time Series

Results for a single sample



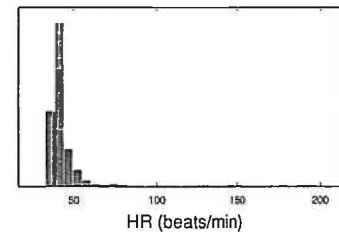
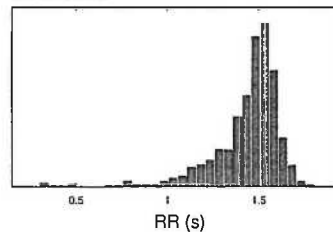
Selected Detrended RR Series



Time-Domain Results

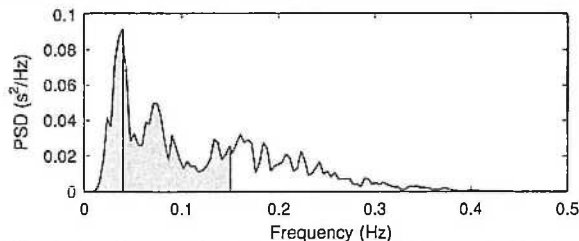
Variable	Units	Value
Mean RR*	(ms)	1438.8
STD RR (SDNN)	(ms)	92.4
Mean HR*	(1/min)	43.07
STD HR	(1/min)	8.47
RMSSD	(ms)	99.2
NN50	(count)	627
pNN50	(%)	50.1
RR triangular index		20.194
TINN	(ms)	555.0

Distributions*

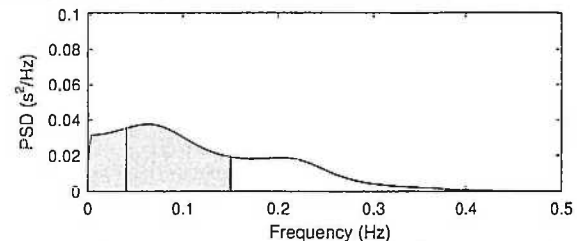


Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



AR Spectrum (AR model order = 16, not factorized)



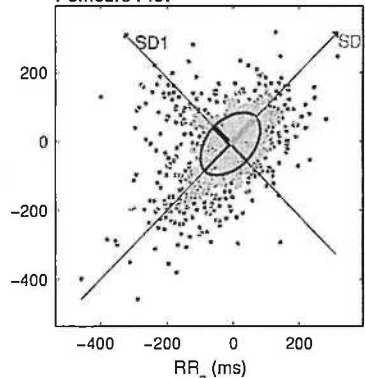
Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	1287	19.2	
LF (0.04-0.15 Hz)	0.0430	3041	45.3	56.0
HF (0.15-0.4 Hz)	0.1602	2385	35.5	43.9
Total		6714		
LF/HF		1.275		

Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	1282	18.5	
LF (0.04-0.15 Hz)	0.0625	3334	48.1	59.0
HF (0.15-0.4 Hz)	0.1523	2318	33.4	41.0
Total		6935		
LF/HF		1.438		

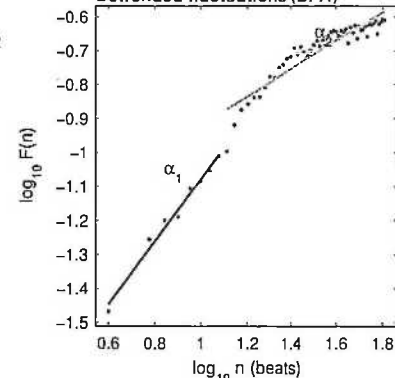
Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	70.2
SD2	(ms)	110.1
Recurrence plot		
Mean line length (Lmean)	(beats)	10.95
Max line length (Lmax)	(beats)	92
Recurrence rate (REC)	(%)	32.15
Determinism (DET)	(%)	98.11
Shannon Entropy (ShanEn)		3.230
Other		
Approximate entropy (ApEn)		1.442
Sample entropy (SampEn)		1.537
Detrended fluctuations (DFA): α1		0.922
Detrended fluctuations (DFA): α2		0.415
Correlation dimension (D2)		4.593
Multiscale entropy (MSE)		0.245 - 1.537

Poincare Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

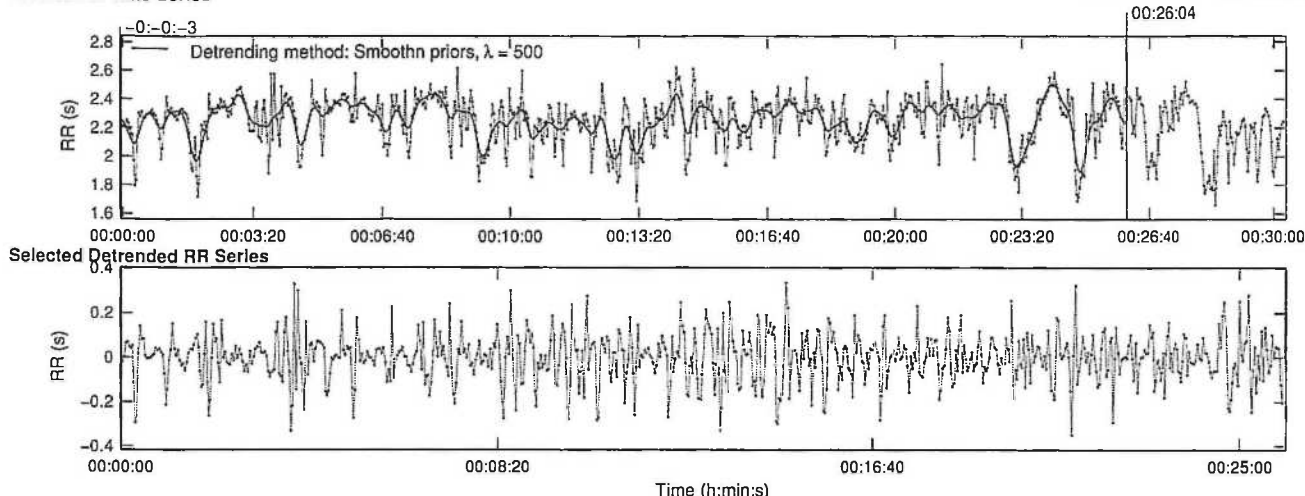
HRV Analysis Results

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RR Interval Time Series

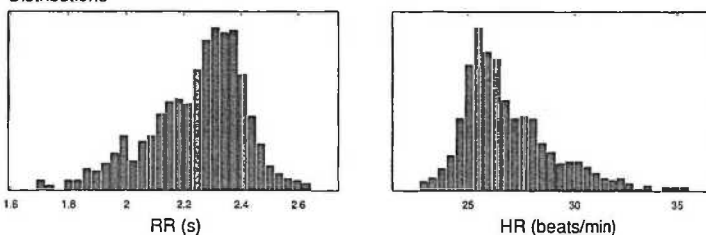
Results for a single sample



Time-Domain Results

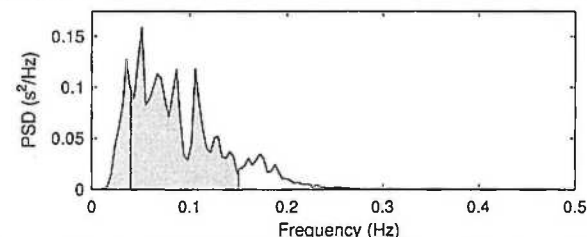
Variable	Units	Value
Mean RR*	(ms)	2245.0
STD RR (SDNN)	(ms)	108.8
Mean HR*	(1/min)	26.89
STD HR	(1/min)	2.07
RMSSD	(ms)	130.3
NN50	(count)	411
pNN50	(%)	58.6
RR triangular index		17.550
TINN	(ms)	520.0

Distributions*



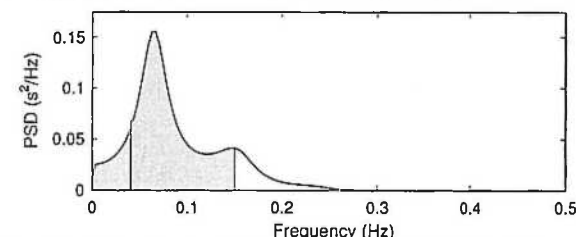
Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



Frequency Band	Peak (Hz)	Power (ms^2)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0352	1575	14.5	
LF (0.04-0.15 Hz)	0.0508	7951	73.0	85.4
HF (0.15-0.4 Hz)	0.1719	1364	12.5	14.6
Total		10890		
LF/HF		5.829		

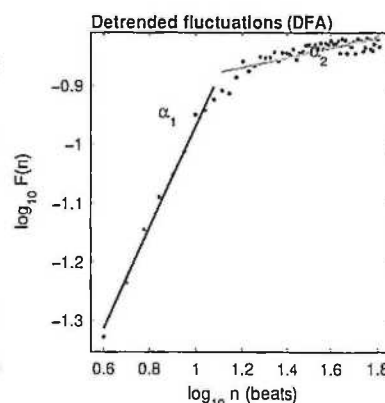
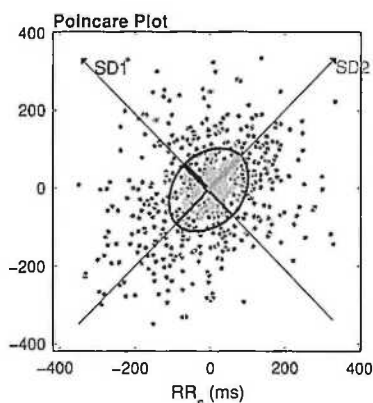
AR Spectrum (AR model order = 16, not factorized)



Frequency Band	Peak (Hz)	Power (ms^2)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	1338	12.6	
LF (0.04-0.15 Hz)	0.0664	7910	74.5	85.2
HF (0.15-0.4 Hz)	0.1523	1373	12.9	14.8
Total		10620		
LF/HF		5.761		

Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	92.2
SD2	(ms)	122.9
Recurrence plot		
Mean line length (Lmean)	(beats)	7.54
Max line length (Lmax)	(beats)	42
Recurrence rate (REC)	(%)	21.90
Determinism (DET)	(%)	96.35
Shannon Entropy (ShanEn)		2.781
Other		
Approximate entropy (ApEn)		1.364
Sample entropy (SampEn)		1.670
Detrended fluctuations (DFA): α_1		0.862
Detrended fluctuations (DFA): α_2		0.084
Correlation dimension (D2)		4.061
Multiscale entropy (MSE)		0.074 - 1.670



*Results are calculated from the non-detrended selected RR series.

HRV Analysis Results

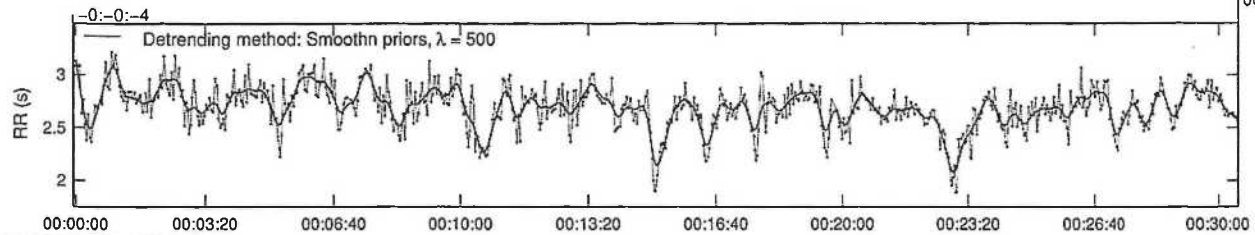
chance baseline HR data 2 20 09 16.txt - xx/xx/xx - xx:xx:xx

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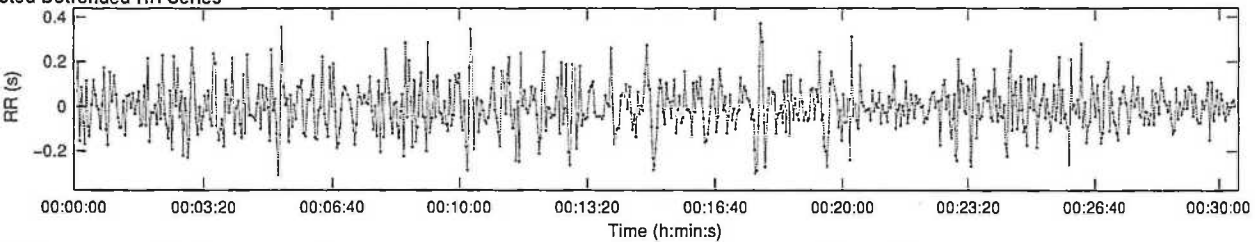
RR Interval Time Series

Results for a single sample

00:30:32



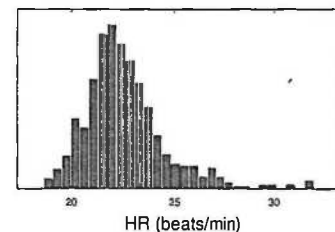
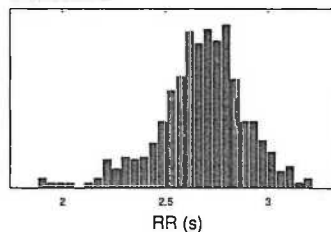
Selected Detrended RR Series



Time-Domain Results

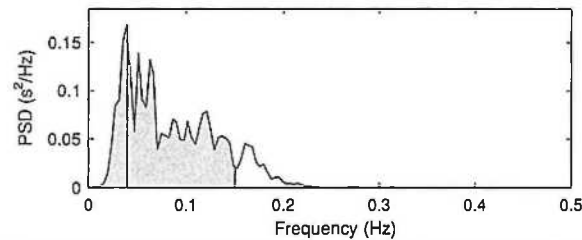
Variable	Units	Value
Mean RR*	(ms)	2674.7
STD RR (SDNN)	(ms)	110.1
Mean HR*	(1/min)	22.59
STD HR	(1/min)	1.74
RMSSD	(ms)	150.7
NN50	(count)	502
pNN50	(%)	72.5
RR triangular index		24.750
TINN	(ms)	535.0

Distributions*



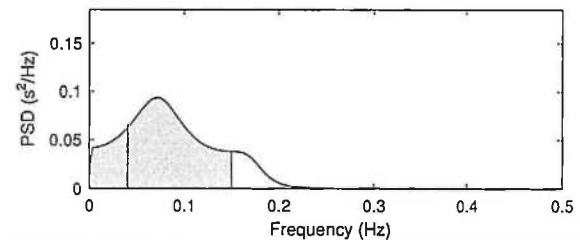
Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	2005	18.6	
LF (0.04-0.15 Hz)	0.0508	7500	69.4	85.2
HF (0.15-0.4 Hz)	0.1602	1302	12.0	14.8
Total		10807		
LF/HF		5.763		

AR Spectrum (AR model order = 16, not factorized)

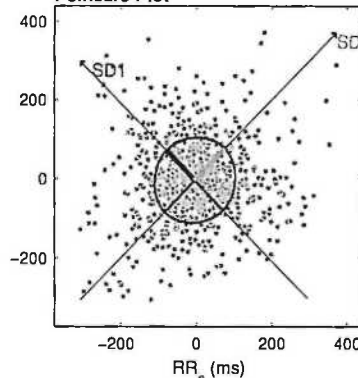


Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	1884	18.1	
LF (0.04-0.15 Hz)	0.0703	7159	68.9	84.2
HF (0.15-0.4 Hz)	0.1523	1342	12.9	15.8
Total		10385		
LF/HF		5.334		

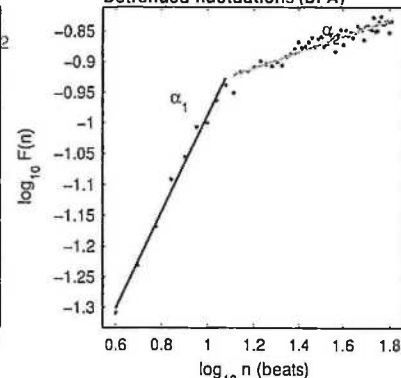
Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	106.6
SD2	(ms)	113.5
Recurrence plot		
Mean line length (Lmean)	(beats)	6.74
Max line length (Lmax)	(beats)	71
Recurrence rate (REC)	(%)	18.83
Determinism (DET)	(%)	94.75
Shannon Entropy (ShanEn)		2.624
Other		
Approximate entropy (ApEn)		1.468
Sample entropy (SampEn)		2.065
Detrended fluctuations (DFA): α_1		0.786
Detrended fluctuations (DFA): α_2		0.130
Correlation dimension (D2)		1.719
Multiscale entropy (MSE)		0.134 - 2.065

Poincare Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

HRV Analysis Results

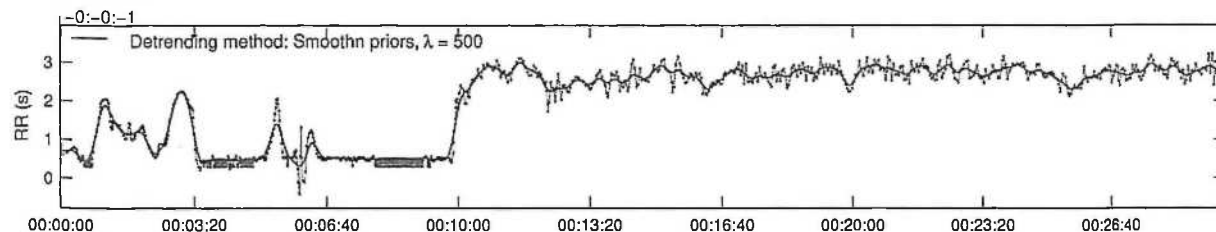
Chance baseline HR data 3 21 09 16.txt - xx/xx/xx - xx:xx:xx

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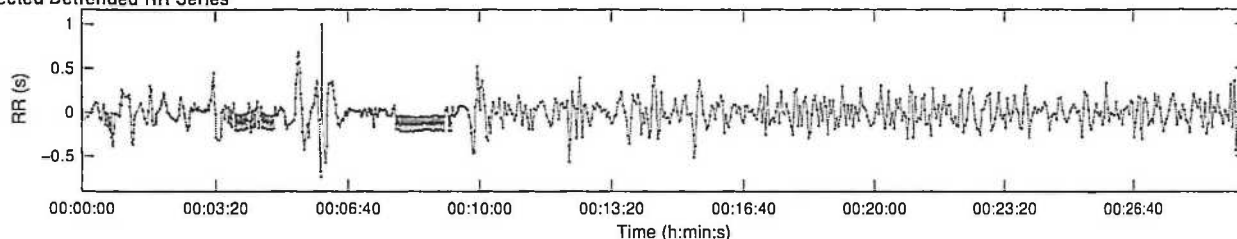
RR Interval Time Series

Results for a single sample

00:29:38



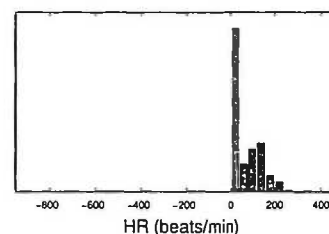
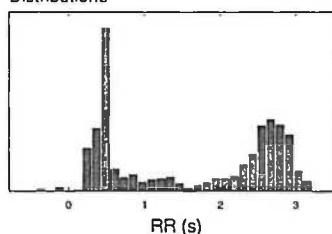
Selected Detrended RR Series



Time-Domain Results

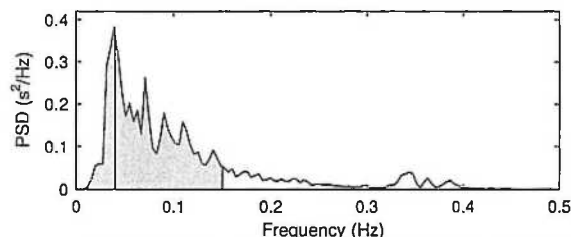
Variable	Units	Value
Mean RR*	(ms)	1621.0
STD RR (SDNN)	(ms)	162.6
Mean HR*	(1/min)	68.64
STD HR	(1/min)	52.03
RMSSD	(ms)	153.0
NN50	(count)	630
pNN50	(%)	65.6
RR triangular index		26.722
TINN	(ms)	1215.0

Distributions*



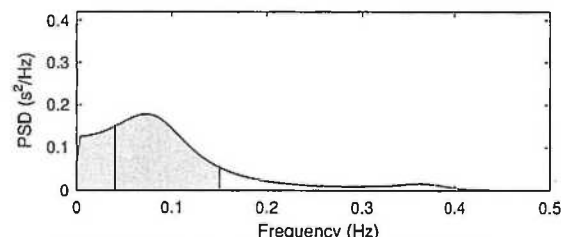
Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	4308	18.1	
LF (0.04-0.15 Hz)	0.0430	15075	63.2	77.1
HF (0.15-0.4 Hz)	0.1523	4468	18.7	22.9
Total		23860		
LF/HF		3.374		

AR Spectrum (AR model order = 16, not factorized)

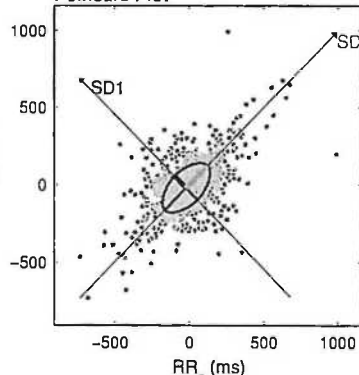


Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	5196	21.8	
LF (0.04-0.15 Hz)	0.0742	14603	61.2	78.2
HF (0.15-0.4 Hz)	0.1523	4057	17.0	21.7
Total		23866		
LF/HF		3.600		

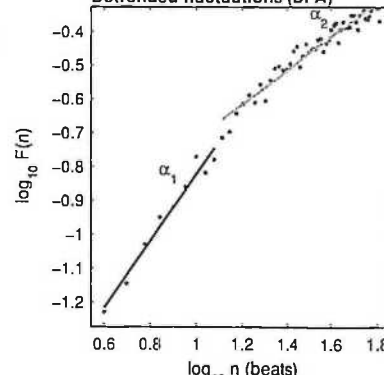
Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	108.3
SD2	(ms)	202.9
Recurrence plot		
Mean line length (Lmean)	(beats)	11.05
Max line length (Lmax)	(beats)	279
Recurrence rate (REC)	(%)	35.75
Determinism (DET)	(%)	97.89
Shannon Entropy (ShanEn)		3.161
Other		
Approximate entropy (ApEn)		1.196
Sample entropy (SampEn)		0.930
Detrended fluctuations (DFA): α1		0.985
Detrended fluctuations (DFA): α2		0.505
Correlation dimension (D2)		0.924
Multiscale entropy (MSE)		0.299 - 1.152

Poincare Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

HRV Analysis Results

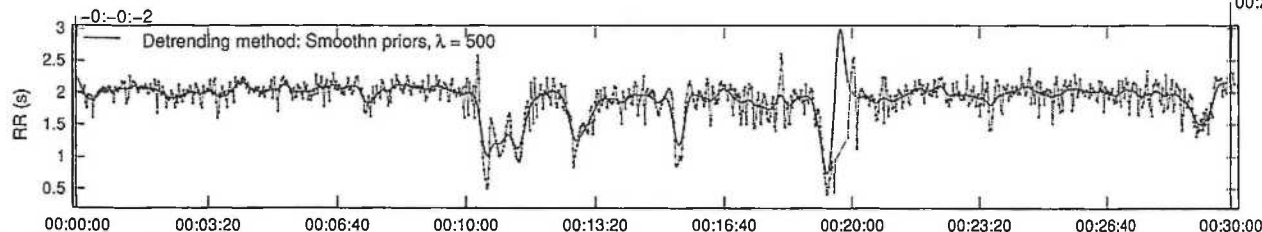
CHANCE HR DATA day 2 week 4 loose hay.txt - xx/xx/xx - xx:xx:xx

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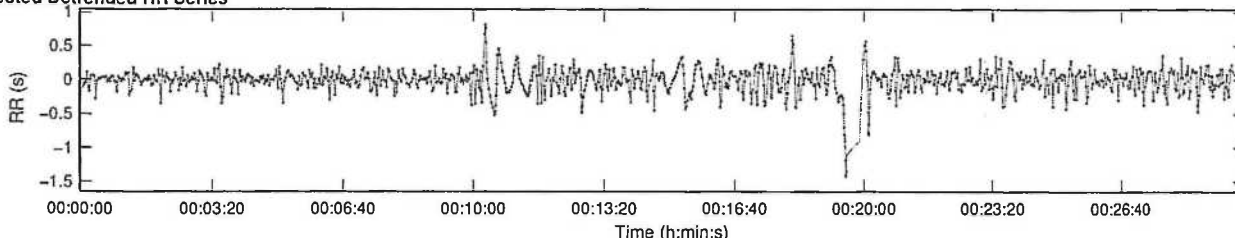
RR Interval Time Series

Results for a single sample

00:29:58



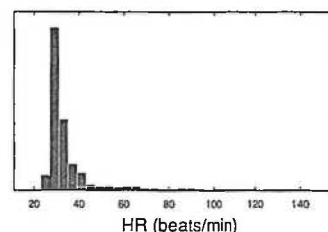
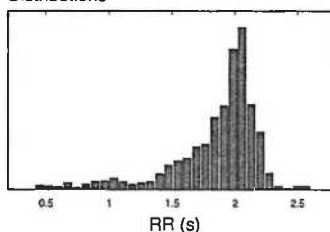
Selected Detrended RR Series



Time-Domain Results

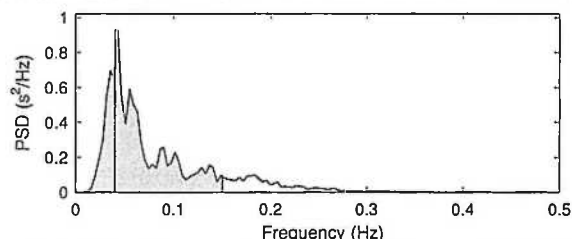
Variable	Units	Value
Mean RR*	(ms)	1849.6
STD RR (SDNN)	(ms)	206.2
Mean HR*	(1/min)	34.72
STD HR	(1/min)	10.73
RMSSD	(ms)	167.7
NN50	(count)	718
pNN50	(%)	69.8
RR triangular index		35.517
TINN	(ms)	1555.0

Distributions*

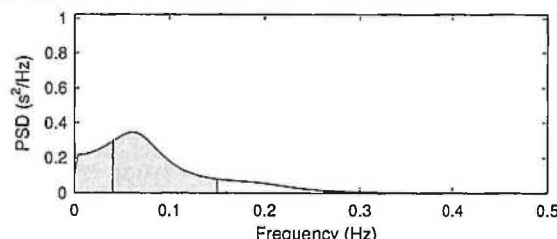


Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



AR Spectrum (AR model order = 16, not factorized)

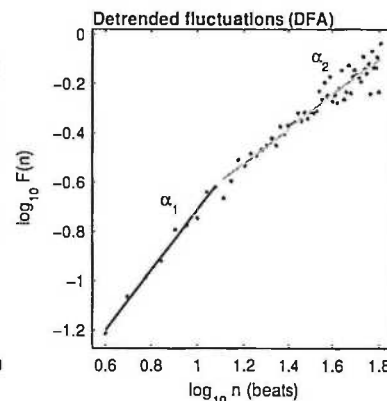
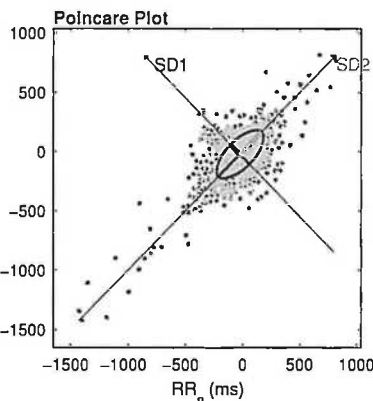


Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0352	9115	21.8	
LF (0.04-0.15 Hz)	0.0430	26729	63.9	81.6
HF (0.15-0.4 Hz)	0.1836	6012	14.4	18.4
Total		41859		
LF/HF		4.446		

Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	9461	24.6	
LF (0.04-0.15 Hz)	0.0625	23300	60.6	80.4
HF (0.15-0.4 Hz)	0.1523	5684	14.8	19.6
Total		38446		
LF/HF		4.099		

Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	118.6
SD2	(ms)	266.5
Recurrence plot		
Mean line length (Lmean)	(beats)	15.87
Max line length (Lmax)	(beats)	286
Recurrence rate (REC)	(%)	48.88
Determinism (DET)	(%)	98.80
Shannon Entropy (ShanEn)		3.596
Other		
Approximate entropy (ApEn)		1.392
Sample entropy (SampEn)		1.483
Detrended fluctuations (DFA): α1		1.225
Detrended fluctuations (DFA): α2		0.700
Correlation dimension (D2)		0.223
Multiscale entropy (MSE)		0.181 - 1.483



*Results are calculated from the non-detrended selected RR series.

HRV Analysis Results

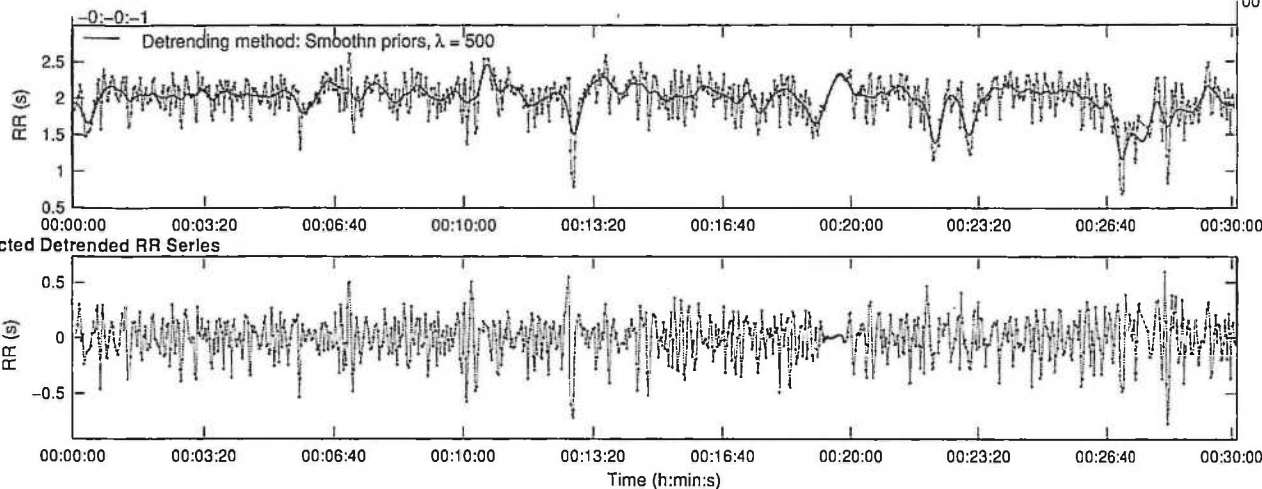
22 10 16 CHANCE loose hay week 5 day 10.txt - xx/xx/xx - xx:xx:xx

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RR Interval Time Series

Results for a single sample

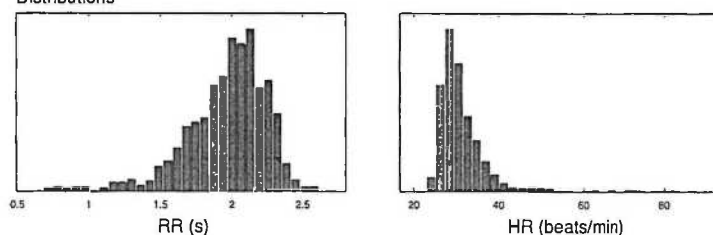
00:30:08



Time-Domain Results

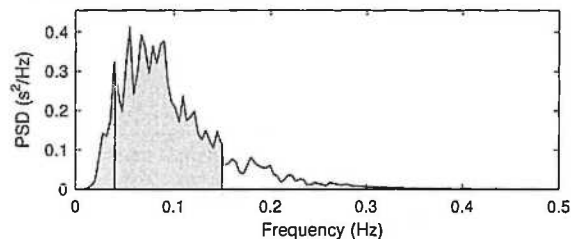
Variable	Units	Value
Mean RR*	(ms)	1967.5
STD RR (SDNN)	(ms)	189.2
Mean HR*	(1/min)	31.40
STD HR	(1/min)	5.82
RMSSD	(ms)	194.2
NN50	(count)	734
pNN50	(%)	75.7
RR triangular index		37.346
TINN	(ms)	1055.0

Distributions*



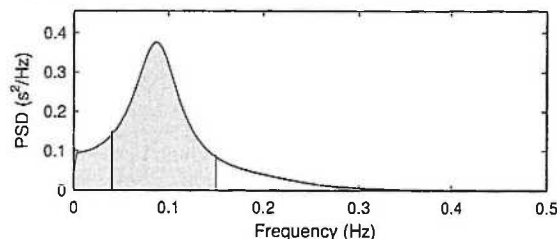
Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	3132	8.9	
LF (0.04-0.15 Hz)	0.0547	26733	76.4	83.9
HF (0.15-0.4 Hz)	0.1797	5140	14.7	16.1
Total		35007		
LF/HF		5.201		

AR Spectrum (AR model order = 16, not factorized)

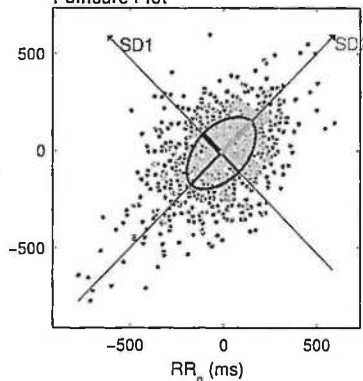


Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	4249	12.3	
LF (0.04-0.15 Hz)	0.0859	25176	73.1	83.3
HF (0.15-0.4 Hz)	0.1523	5036	14.6	16.7
Total		34463		
LF/HF		4.999		

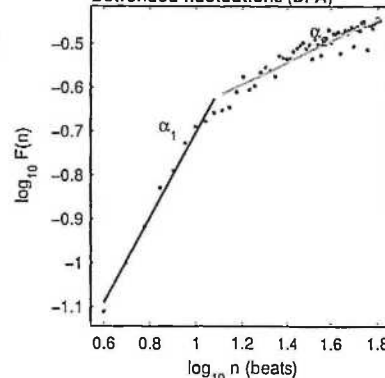
Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	137.4
SD2	(ms)	229.7
Recurrence plot		
Mean line length (Lmean)	(beats)	7.83
Max line length (Lmax)	(beats)	61
Recurrence rate (REC)	(%)	24.74
Determinism (DET)	(%)	96.33
Shannon Entropy (ShanEn)		2.838
Other		
Approximate entropy (ApEn)		1.449
Sample entropy (SampEn)		1.633
Detrended fluctuations (DFA): α_1		0.974
Detrended fluctuations (DFA): α_2		0.248
Correlation dimension (D2)		0.266
Multiscale entropy (MSE)		0.239 - 1.732

Poincare Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

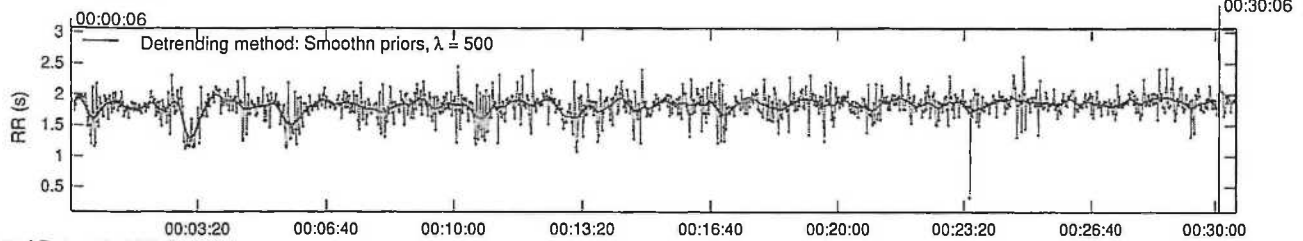
HRV Analysis Results

CHANCE LOOSE HAY DAY 21 01 11 16 edittttttt.txt - xx/xx/xx - xx:xx:xx

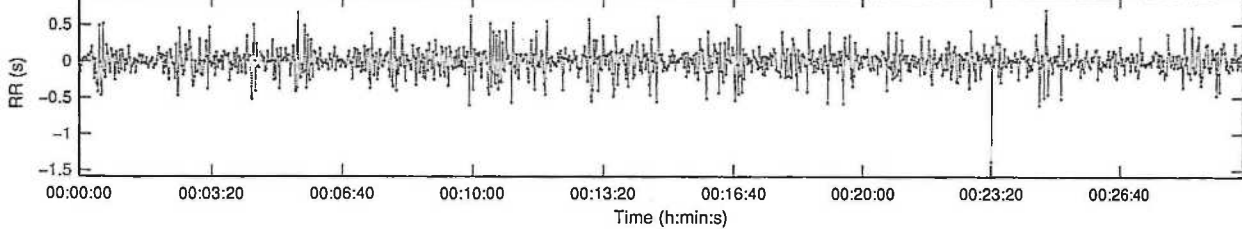
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RR Interval Time Series

Results for a single sample



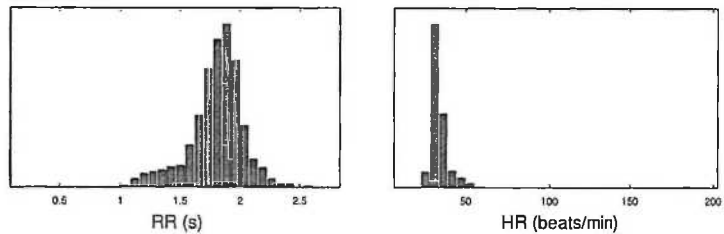
Selected Detrended RR Series



Time-Domain Results

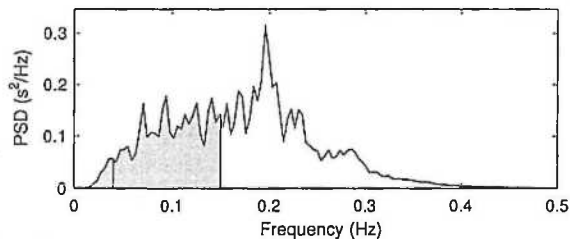
Variable	Units	Value
Mean RR*	(ms)	1803.1
STD RR (SDNN)	(ms)	192.5
Mean HR*	(1/min)	33.98
STD HR	(1/min)	6.66
RMSSD	(ms)	296.5
NN50	(count)	816
pNN50	(%)	81.9
RR triangular index		36.926
TINN	(ms)	1455.0

Distributions*



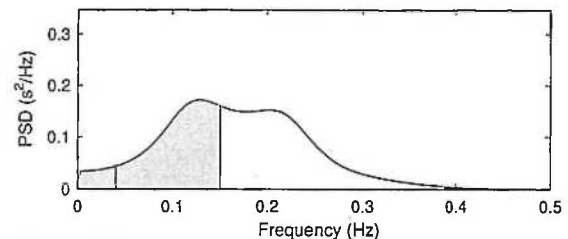
Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	744	2.2	
LF (0.04-0.15 Hz)	0.0938	12517	37.7	38.6
HF (0.15-0.4 Hz)	0.1953	19897	60.0	61.4
Total		33167		
LF/HF		0.629		

AR Spectrum (AR model order = 16, not factorized)

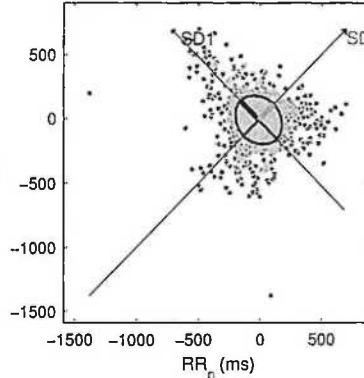


Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	1433	4.5	
LF (0.04-0.15 Hz)	0.1289	12735	39.7	41.6
HF (0.15-0.4 Hz)	0.1523	17883	55.8	58.4
Total		32057		
LF/HF		0.712		

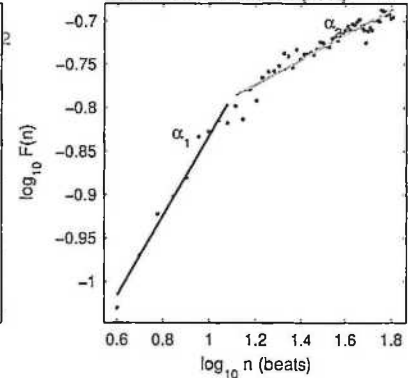
Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	209.7
SD2	(ms)	173.7
Recurrence plot		
Mean line length (Lmean)	(beats)	8.14
Max line length (Lmax)	(beats)	83
Recurrence rate (REC)	(%)	26.16
Determinism (DET)	(%)	96.81
Shannon Entropy (ShanEn)		2.869
Other		
Approximate entropy (ApEn)		1.560
Sample entropy (SampEn)		1.850
Detrended fluctuations (DFA): α_1		0.461
Detrended fluctuations (DFA): α_2		0.144
Correlation dimension (D2)		0.011
Multiscale entropy (MSE)		0.028 - 1.850

Poincare Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

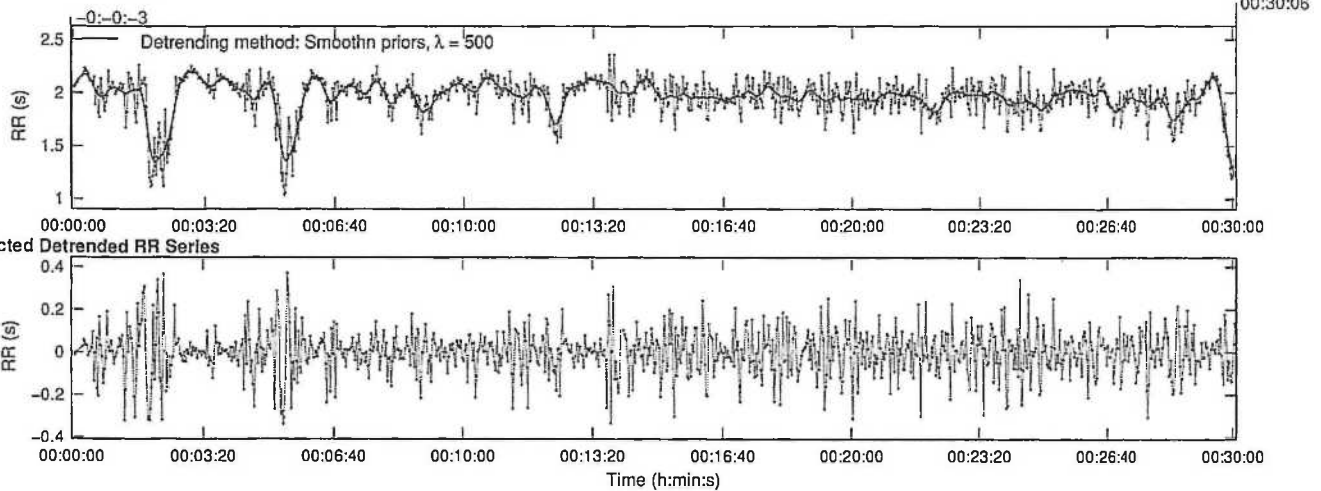
HRV Analysis Results

CHANCE HAYNET 03 11 16 DAY 2.txt - xx/xx/xx - xx:xx:xx

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RR Interval Time Series

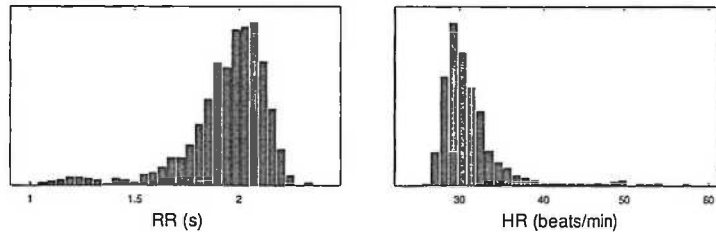
Results for a single sample



Time-Domain Results

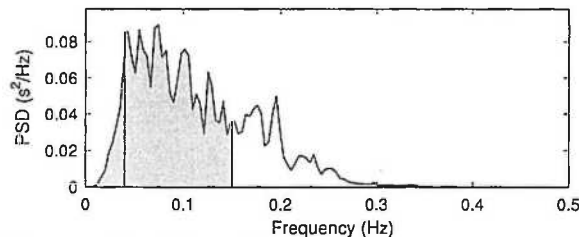
Variable	Units	Value
Mean RR*	(ms)	1940.7
STD RR (SDNN)	(ms)	108.4
Mean HR*	(1/min)	31.36
STD HR	(1/min)	3.65
RMSSD	(ms)	136.0
NN50	(count)	611
pNN50	(%)	64.9
RR triangular index		19.625
TINN	(ms)	535.0

Distributions*



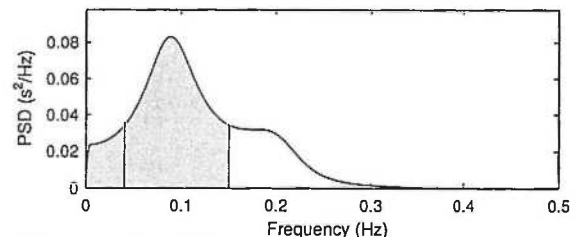
Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	727	7.2	
LF (0.04-0.15 Hz)	0.0742	6626	65.8	70.9
HF (0.15-0.4 Hz)	0.1953	2714	27.0	29.1
Total		10068		
LF/HF		2.441		

AR Spectrum (AR model order = 16, not factorized)

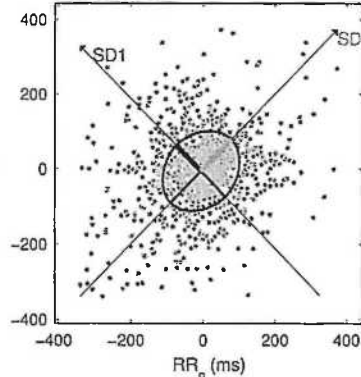


Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	1042	10.4	
LF (0.04-0.15 Hz)	0.0898	6323	63.0	70.3
HF (0.15-0.4 Hz)	0.1523	2665	26.6	29.6
Total		10029		
LF/HF		2.373		

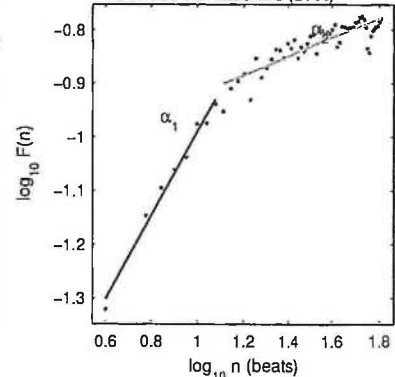
Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	96.2
SD2	(ms)	119.4
Recurrence plot		
Mean line length (Lmean)	(beats)	8.55
Max line length (Lmax)	(beats)	61
Recurrence rate (REC)	(%)	25.68
Determinism (DET)	(%)	96.43
Shannon Entropy (ShanEn)		2.933
Other		
Approximate entropy (ApEn)		1.498
Sample entropy (SampEn)		1.779
Detrended fluctuations (DFA): α1		0.779
Detrended fluctuations (DFA): α2		0.179
Correlation dimension (D2)		4.240
Multiscale entropy (MSE)		0.091 - 1.779

Poincare Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

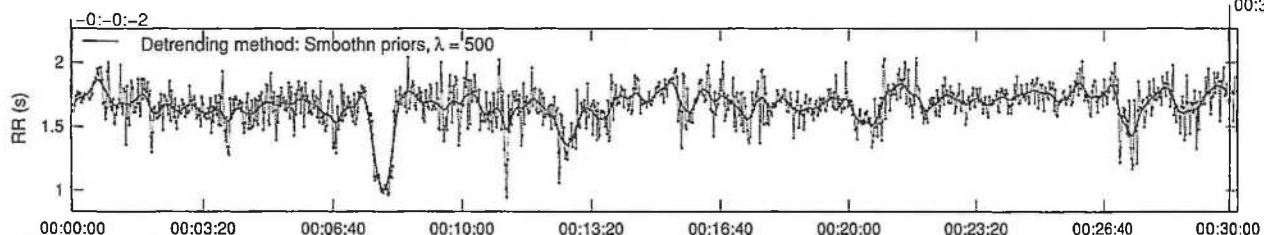
HRV Analysis Results

chance haynet day 10 11 11 16.txt - xx/xx/xx - xx:xx:xx

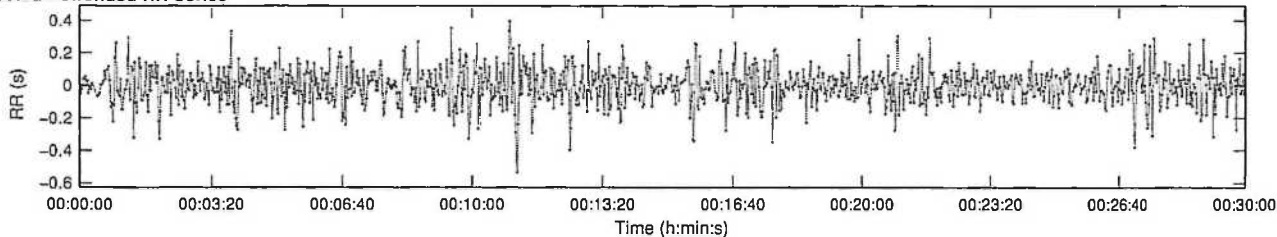
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RR Interval Time Series

Results for a single sample



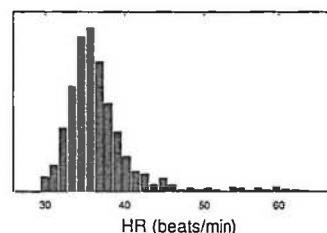
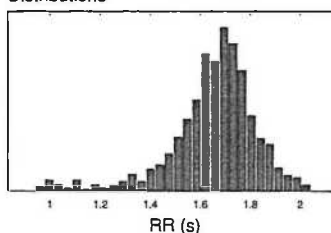
Selected Detrended RR Series



Time-Domain Results

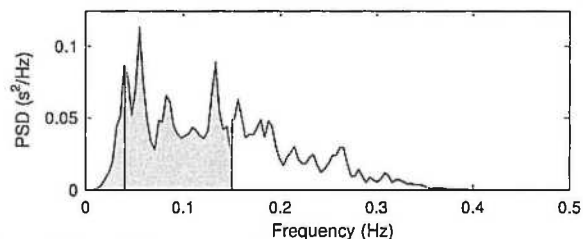
Variable	Units	Value
Mean RR*	(ms)	1652.3
STD RR (SDNN)	(ms)	111.3
Mean HR*	(1/min)	36.81
STD HR	(1/min)	4.02
RMSSD	(ms)	147.5
NN50	(count)	760
pNN50	(%)	69.3
RR triangular index		28.154
TINN	(ms)	685.0

Distributions*



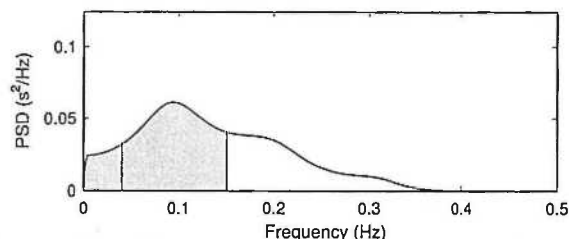
Frequency-Domain Results

FFT spectrum (Welch's periodogram; 256 s window with 50% overlap)



Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	786	7.3	
LF (0.04-0.15 Hz)	0.0547	5692	53.2	57.5
HF (0.15-0.4 Hz)	0.1563	4213	39.4	42.5
Total		10691		
LF/HF		1.351		

AR Spectrum (AR model order = 16, not factorized)

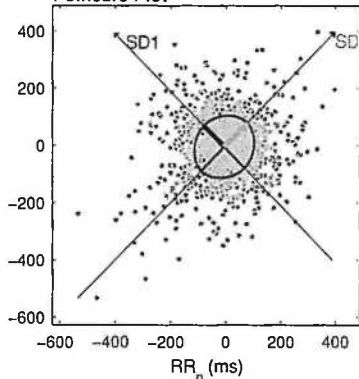


Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	1036	9.8	
LF (0.04-0.15 Hz)	0.0938	5454	51.6	57.2
HF (0.15-0.4 Hz)	0.1523	4080	38.6	42.8
Total		10571		
LF/HF		1.337		

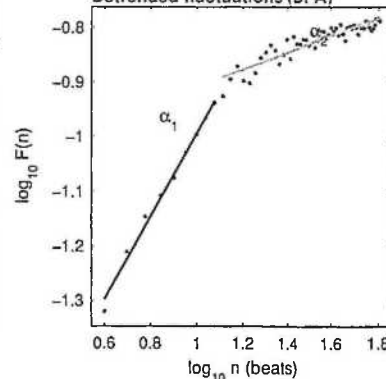
Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	104.4
SD2	(ms)	117.8
Recurrence plot		
Mean line length (Lmean)	(beats)	8.67
Max line length (Lmax)	(beats)	105
Recurrence rate (REC)	(%)	24.96
Determinism (DET)	(%)	96.23
Shannon Entropy (ShanEn)		2.946
Other		
Approximate entropy (ApEn)		1.548
Sample entropy (SampEn)		1.932
Detrended fluctuations (DFA): α_1		0.761
Detrended fluctuations (DFA): α_2		0.156
Correlation dimension (D2)		4.049
Multiscale entropy (MSE)		0.121 - 1.932

Poincare Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

HRV Analysis Results

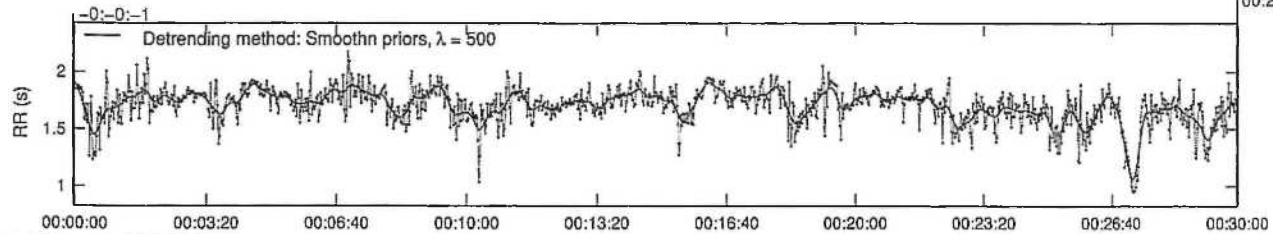
CHANCE HAYNET 21 11 16 END.txt - xx/xx/xx - xx:xx:xx

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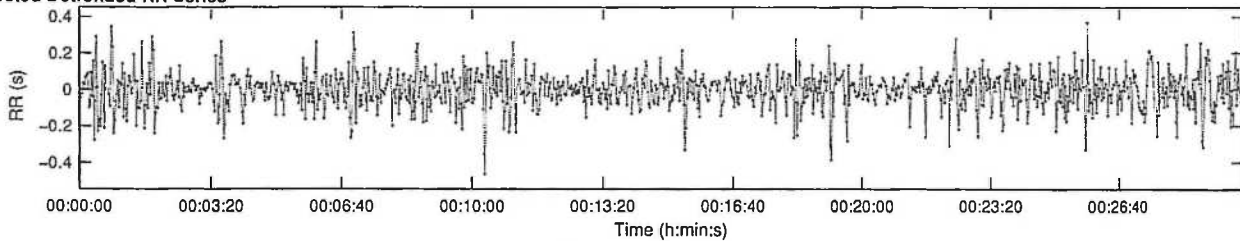
RR Interval Time Series

Results for a single sample

00:29:59



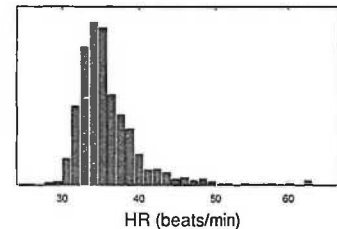
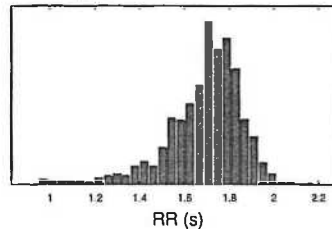
Selected Detrended RR Series



Time-Domain Results

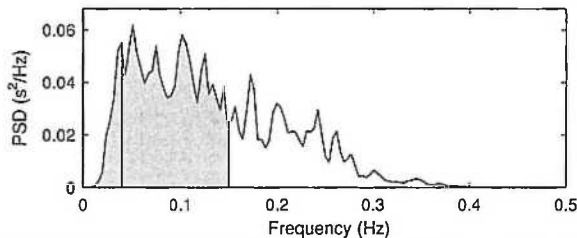
Variable	Units	Value
Mean RR*	(ms)	1690.5
STD RR (SDNN)	(ms)	100.5
Mean HR*	(1/min)	35.94
STD HR	(1/min)	3.71
RMSSD	(ms)	130.9
NN50	(count)	688
pNN50	(%)	63.9
RR triangular index		21.560
TINN	(ms)	610.0

Distributions*



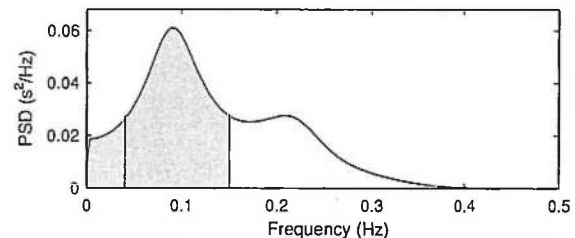
Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	702	8.2	
LF (0.04-0.15 Hz)	0.0508	4771	55.7	60.6
HF (0.15-0.4 Hz)	0.1719	3098	36.1	39.4
Total		8571		
LF/HF		1.540		

AR Spectrum (AR model order = 16, not factorized)

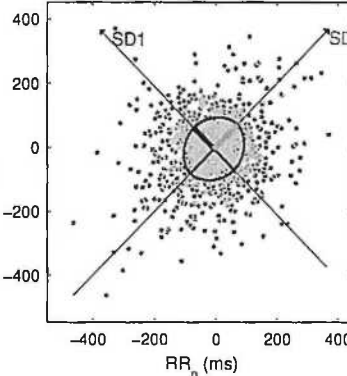


Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	819	9.2	
LF (0.04-0.15 Hz)	0.0898	4810	54.3	59.8
HF (0.15-0.4 Hz)	0.2109	3230	36.5	40.2
Total		8859		
LF/HF		1.489		

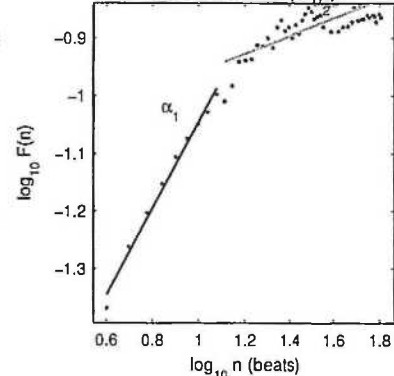
Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	92.6
SD2	(ms)	107.8
Recurrence plot		
Mean line length (Lmean)	(beats)	8.93
Max line length (Lmax)	(beats)	86
Recurrence rate (REC)	(%)	26.94
Determinism (DET)	(%)	96.82
Shannon Entropy (ShanEn)		2.961
Other		
Approximate entropy (ApEn)		1.516
Sample entropy (SampEn)		1.824
Detrended fluctuations (DFA): α1		0.750
Detrended fluctuations (DFA): α2		0.154
Correlation dimension (D2)		4.559
Multiscale entropy (MSE)		0.154 - 1.824

Poincare Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

HRV Analysis Results

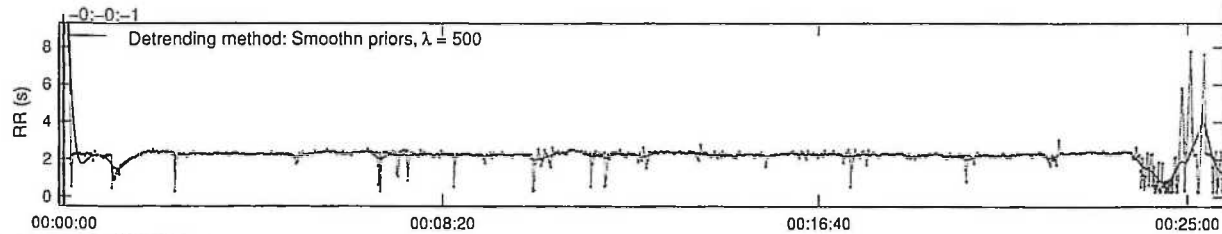
HR data day 2 week 1 CHANCE Slow feeder.txt – xx/xx/xx – xx:xx:xx

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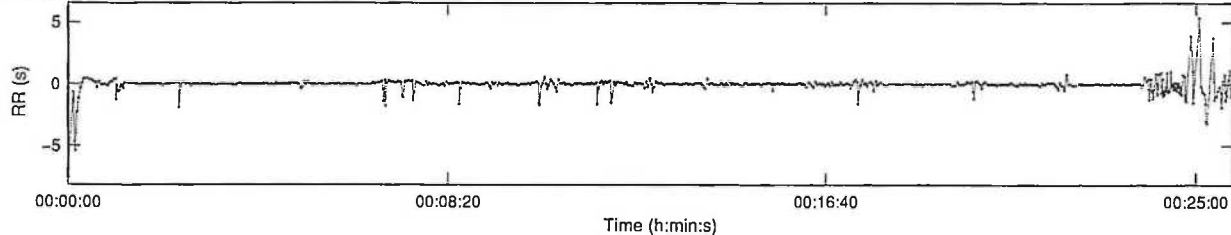
RR Interval Time Series

Results for a single sample

00:25:50



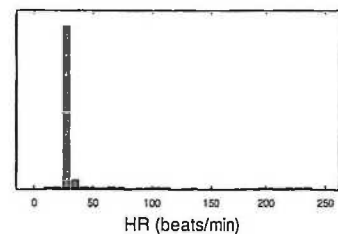
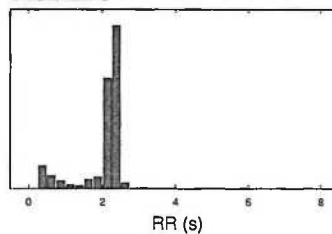
Selected Detrended RR Series



Time-Domain Results

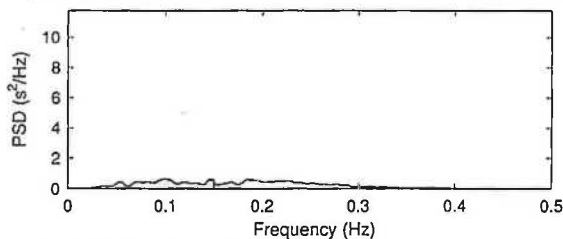
Variable	Units	Value
Mean RR*	(ms)	2053.7
STD RR (SDNN)	(ms)	647.3
Mean HR*	(1/min)	41.23
STD HR	(1/min)	32.33
RMSSD	(ms)	708.8
NN50	(count)	481
pNN50	(%)	63.5
RR triangular index		21.056
TINN	(ms)	2000.0

Distributions*



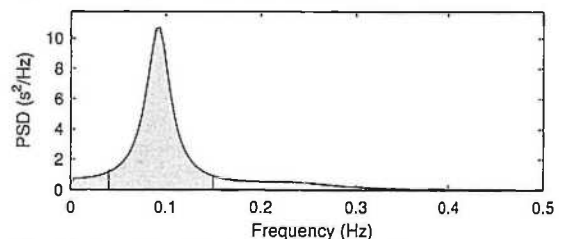
Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0–0.04 Hz)	0.0391	1949	1.8	
LF (0.04–0.15 Hz)	0.0977	42485	40.3	41.0
HF (0.15–0.4 Hz)	0.1836	61056	57.9	58.9
Total		105533		
LF/HF		0.696		

AR Spectrum (AR model order = 16, not factorized)

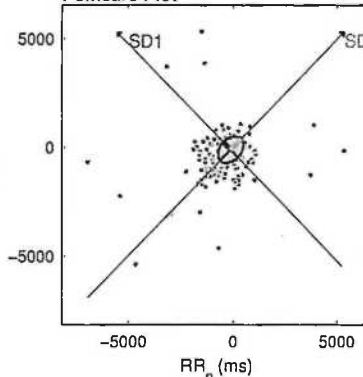


Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0–0.04 Hz)	0.0391	33307	6.0	
LF (0.04–0.15 Hz)	0.0938	445633	79.6	84.7
HF (0.15–0.4 Hz)	0.1523	80563	14.4	15.3
Total		559581		
LF/HF		5.532		α_2

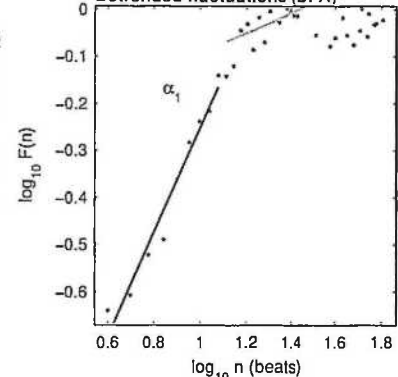
Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	501.5
SD2	(ms)	724.9
Recurrence plot		
Mean line length (Lmean)	(beats)	46.99
Max line length (Lmax)	(beats)	309
Recurrence rate (REC)	(%)	73.32
Determinism (DET)	(%)	99.70
Shannon Entropy (ShanEn)		4.385
Other		
Approximate entropy (ApEn)		0.553
Sample entropy (SampEn)		0.245
Detrended fluctuations (DFA): α_1		1.110
Detrended fluctuations (DFA): α_2		0.212
Correlation dimension (D2)		4.203
Multiscale entropy (MSE)		0.099 – 0.264

Poincare Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

HRV Analysis Results

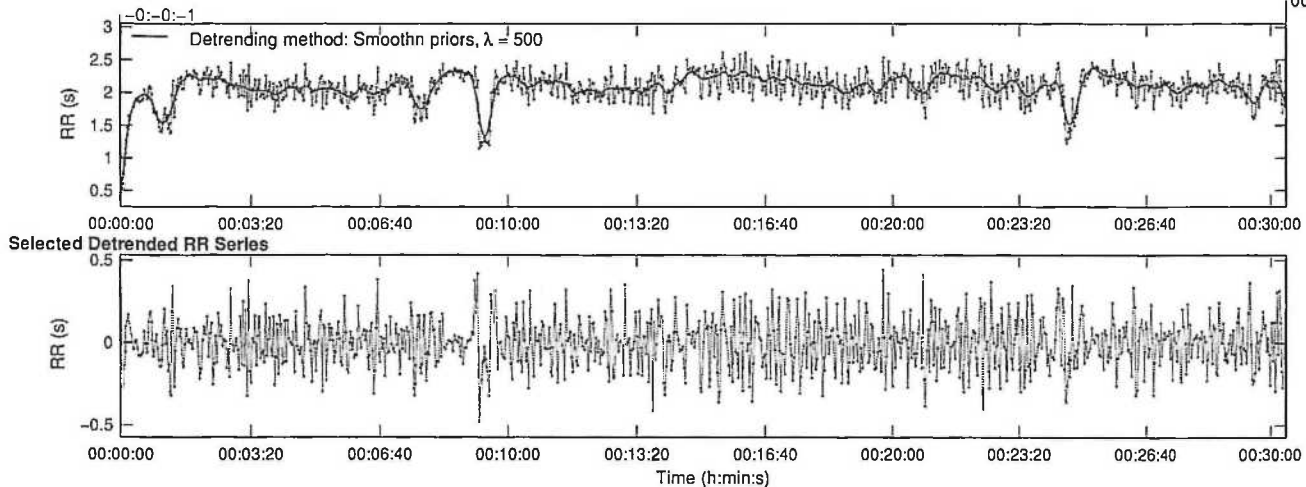
CHANCE HR DATA WEEK 1 DAY 10 30 09 16 SF.txt - xx/xx/xx - xx:xx:xx

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RR Interval Time Series

Results for a single sample

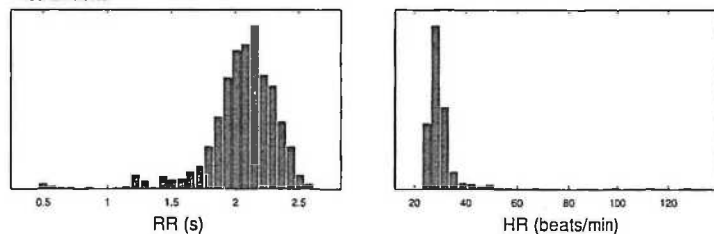
00:30:26



Time-Domain Results

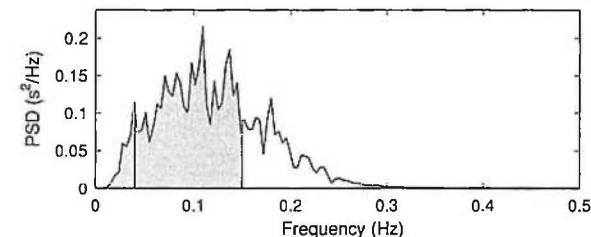
Variable	Units	Value
Mean RR*	(ms)	2050.7
STD RR (SDNN)	(ms)	152.1
Mean HR*	(1/min)	30.29
STD HR	(1/min)	6.25
RMSSD	(ms)	207.3
NN50	(count)	694
pNN50	(%)	76.5
RR triangular index		30.267
TINN	(ms)	750.0

Distributions*



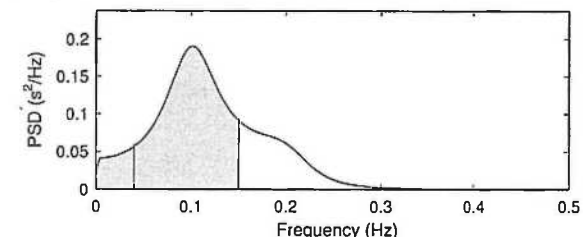
Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



Frequency Band	Peak (Hz)	Power (ms^2)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	1234	6.0	
LF (0.04-0.15 Hz)	0.1094	13586	66.4	70.7
HF (0.15-0.4 Hz)	0.1797	5636	27.6	29.3
Total		20456		
LF/HF		2.411		

AR Spectrum (AR model order = 16, not factorized)

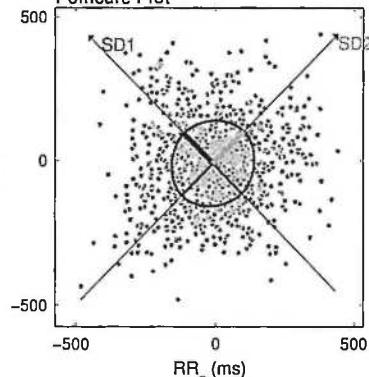


Frequency Band	Peak (Hz)	Power (ms^2)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	1784	8.2	
LF (0.04-0.15 Hz)	0.1016	14123	64.9	70.7
HF (0.15-0.4 Hz)	0.1523	5845	26.9	29.3
Total		21752		
LF/HF		2.416		

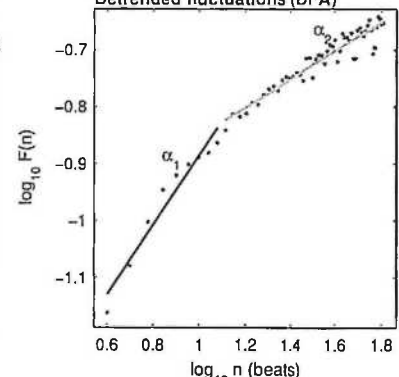
Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	146.6
SD2	(ms)	157.1
Recurrence plot		
Mean line length (Lmean)	(beats)	6.27
Max line length (Lmax)	(beats)	48
Recurrence rate (REC)	(%)	16.55
Determinism (DET)	(%)	94.20
Shannon Entropy (ShanEn)		2.545
Other		
Approximate entropy (ApEn)		1.570
Sample entropy (SampEn)		2.010
Detrended fluctuations (DFA): α_1		0.610
Detrended fluctuations (DFA): α_2		0.251
Correlation dimension (D2)		0.014
Multiscale entropy (MSE)		0.136 - 2.010

Poincare Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

HRV Analysis Results

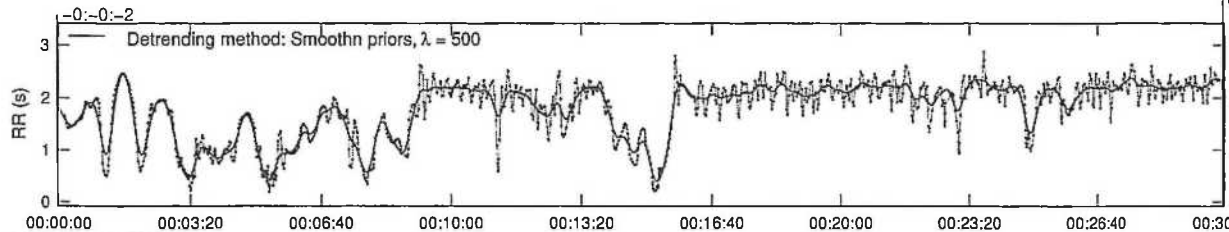
CHANCE HR data 3 day 21 slow feeder 13 10 16.txt - xx/xx/xx - xx:xx:xx

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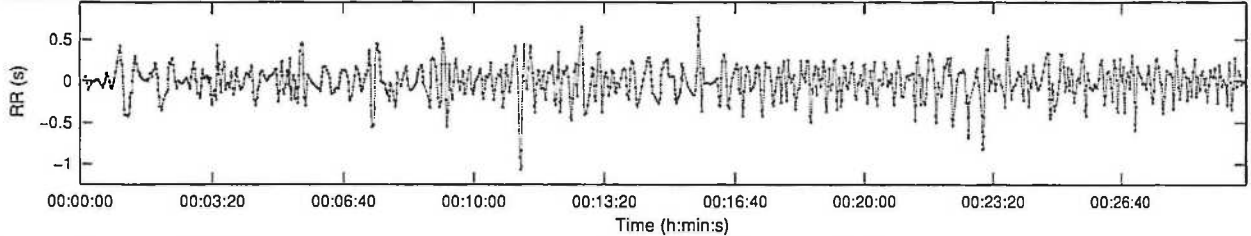
RR Interval Time Series

Results for a single sample

00:29:58



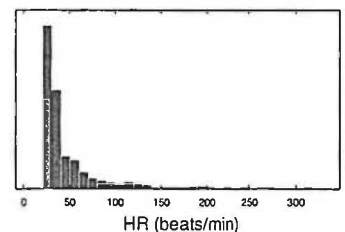
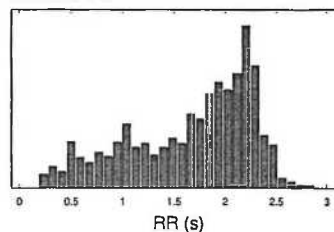
Selected Detrended RR Series



Time-Domain Results

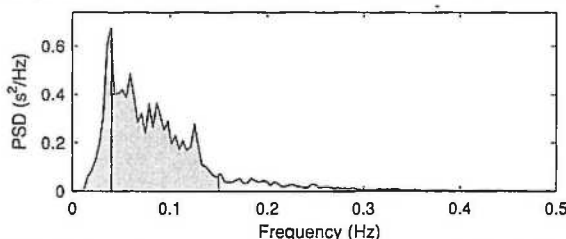
Variable	Units	Value
Mean RR*	(ms)	1670.6
STD RR (SDNN)	(ms)	203.1
Mean HR*	(1/min)	46.58
STD HR	(1/min)	26.00
RMSSD	(ms)	143.8
NN50	(count)	753
pNN50	(%)	62.3
RR triangular index		43.214
TINN	(ms)	1330.0

Distributions*



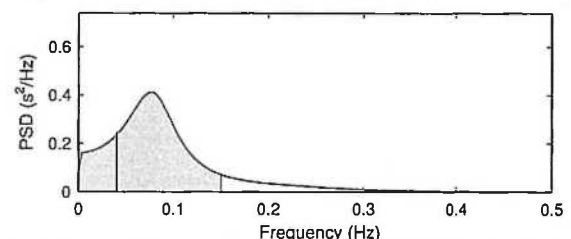
Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	7339	18.0	
LF (0.04-0.15 Hz)	0.0586	28943	71.0	86.6
HF (0.15-0.4 Hz)	0.1523	4471	11.0	13.4
Total		40756		
LF/HF		6.474		

AR Spectrum (AR model order = 16, not factorized)

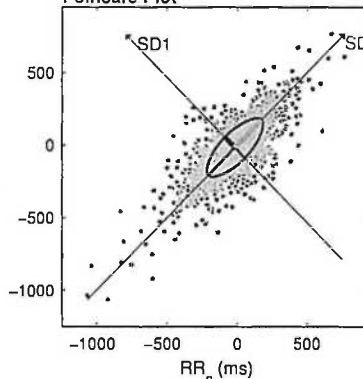


Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	7206	18.1	
LF (0.04-0.15 Hz)	0.0781	27696	69.5	84.8
HF (0.15-0.4 Hz)	0.1523	4964	12.5	15.2
Total		39871		
LF/HF		5.579		

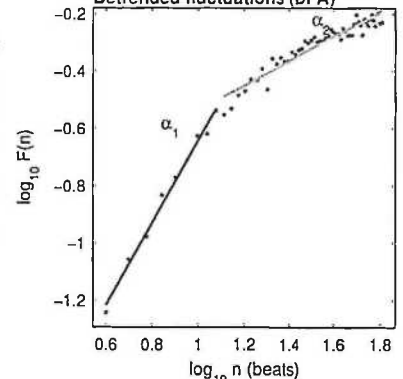
Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	101.7
SD2	(ms)	268.7
Recurrence plot		
Mean line length (Lmean)	(beats)	11.18
Max line length (Lmax)	(beats)	355
Recurrence rate (REC)	(%)	35.87
Determinism (DET)	(%)	98.68
Shannon Entropy (ShanEn)		3.256
Other		
Approximate entropy (ApEn)		1.098
Sample entropy (SampEn)		1.021
Detrended fluctuations (DFA): α1		1.435
Detrended fluctuations (DFA): α2		0.425
Correlation dimension (D2)		2.914
Multiscale entropy (MSE)		0.645 - 1.603

Poincare Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

Appendix 8: Kubios HRV Analysis Results Experiment 2

HRV Analysis Results

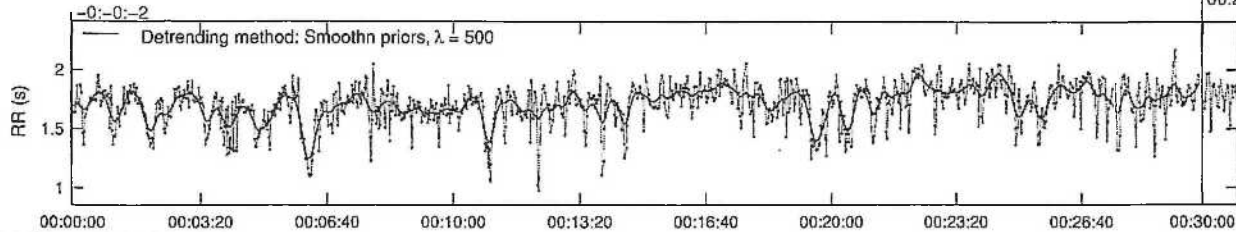
Cameron BASELINE DATA 1.txt - xx/xx/xx - xx:xx:xx

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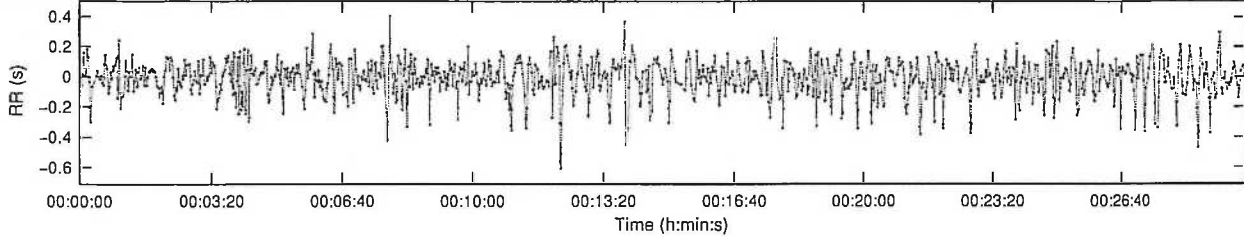
RR Interval Time Series

Results for a single sample

00:29:58



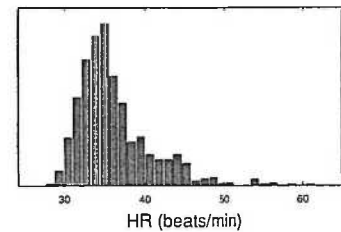
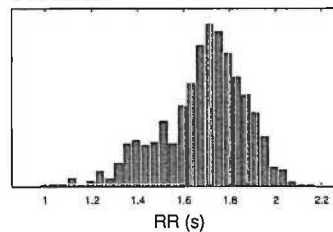
Selected Detrended RR Series



Time-Domain Results

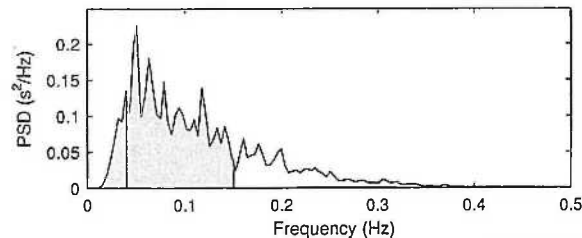
Variable	Units	Value
Mean RR*	(ms)	1682.4
STD RR (SDNN)	(ms)	127.0
Mean HR*	(1/min)	36.16
STD HR	(1/min)	4.08
RMSSD	(ms)	125.0
NN50	(count)	679
pNN50	(%)	63.0
RR triangular index		27.641
TINN	(ms)	760.0

Distributions*



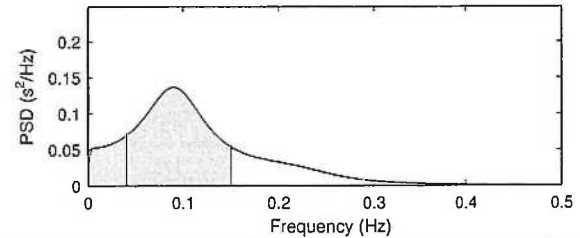
Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	1635	9.3	
LF (0.04-0.15 Hz)	0.0508	11630	66.0	72.7
HF (0.15-0.4 Hz)	0.1602	4356	24.7	27.2
Total		17624		
LF/HF		2.670		

AR Spectrum (AR model order = 16, not factorized)

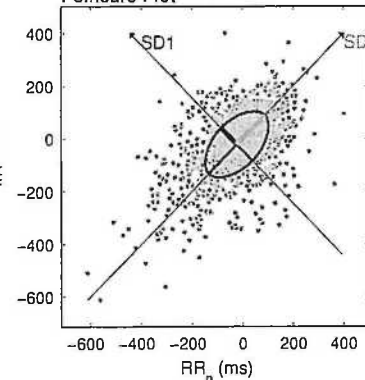


Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	2251	12.9	
LF (0.04-0.15 Hz)	0.0898	10993	63.0	72.3
HF (0.15-0.4 Hz)	0.1523	4204	24.1	27.7
Total		17451		
LF/HF		2.615		

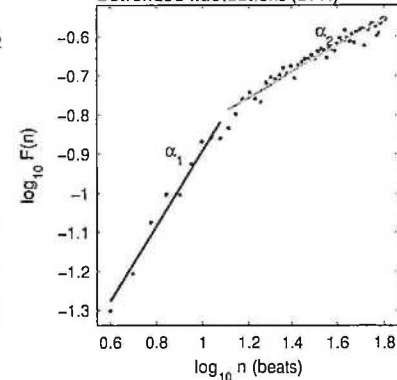
Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	88.4
SD2	(ms)	156.4
Recurrence plot		
Mean line length (Lmean)	(beats)	7.91
Max line length (Lmax)	(beats)	100
Recurrence rate (REC)	(%)	25.39
Determinism (DET)	(%)	96.90
Shannon Entropy (ShanEn)		2.849
Other		
Approximate entropy (ApEn)		1.474
Sample entropy (SampEn)		1.727
Detrended fluctuations (DFA): α1		0.962
Detrended fluctuations (DFA): α2		0.335
Correlation dimension (D2)		2.778
Multiscale entropy (MSE)		0.378 - 1.742

Poincare Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

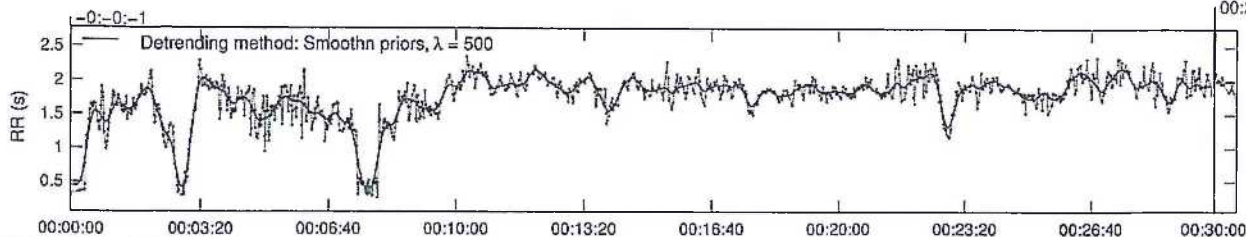
HRV Analysis Results

Cameron Baseline DATA 2.txt - xx/xx/xx - xx:xx:xx

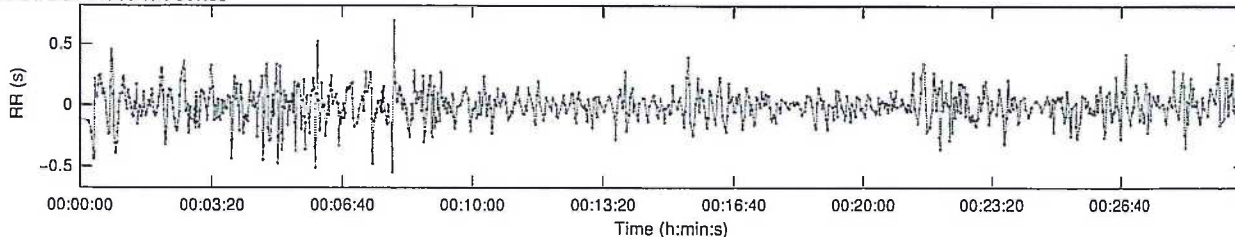
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RR Interval Time Series

Results for a single sample



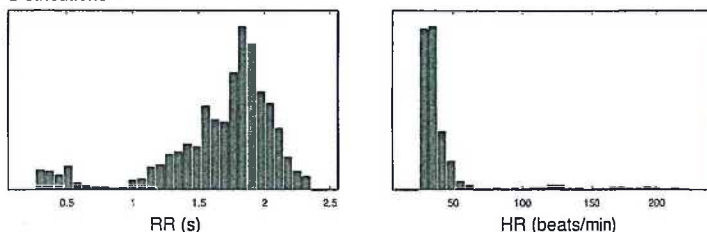
Selected Detrended RR Series



Time-Domain Results

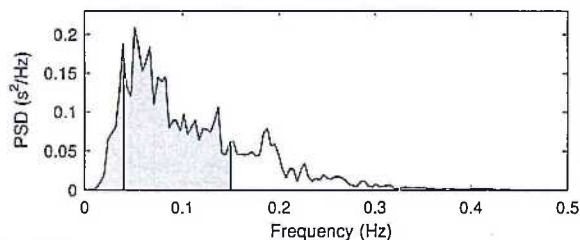
Variable	Units	Value
Mean RR*	(ms)	1661.9
STD RR (SDNN)	(ms)	145.1
Mean HR*	(1/min)	42.93
STD HR	(1/min)	20.65
RMSSD	(ms)	139.3
NN50	(count)	649
pNN50	(%)	66.2
RR triangular index		33.862
TINN	(ms)	910.0

Distributions*

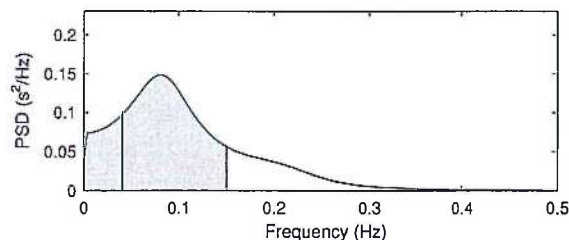


Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



AR Spectrum (AR model order = 16, not factorized)



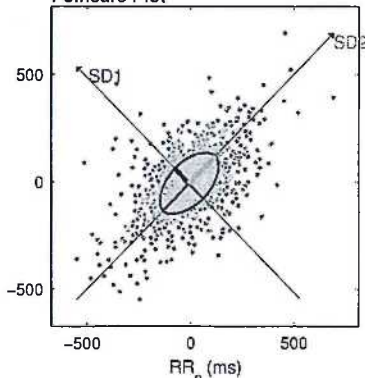
Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	1996	10.8	
LF (0.04-0.15 Hz)	0.0508	11923	64.6	72.4
HF (0.15-0.4 Hz)	0.1875	4538	24.6	27.6
Total		18459		
LF/HF		2.628		

Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	3164	16.1	
LF (0.04-0.15 Hz)	0.0820	12138	61.7	73.5
HF (0.15-0.4 Hz)	0.1523	4365	22.2	26.4
Total		19670		
LF/HF		2.781		

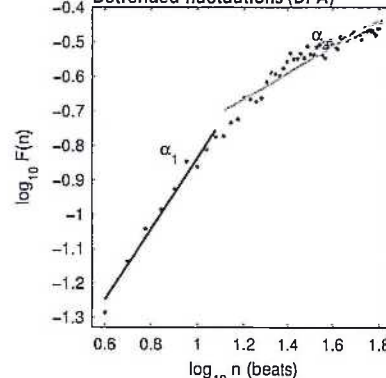
Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	98.6
SD2	(ms)	180.1
Recurrence plot		
Mean line length (Lmean)	(beats)	10.49
Max line length (Lmax)	(beats)	145
Recurrence rate (REC)	(%)	30.62
Determinism (DET)	(%)	97.78
Shannon Entropy (ShanEn)		3.154
Other		
Approximate entropy (ApEn)		1.430
Sample entropy (SampEn)		1.654
Detrended fluctuations (DFA): α1		1.030
Detrended fluctuations (DFA): α2		0.378
Correlation dimension (D2)		2.500
Multiscale entropy (MSE)		0.488 - 1.654

Poincare Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

HRV Analysis Results

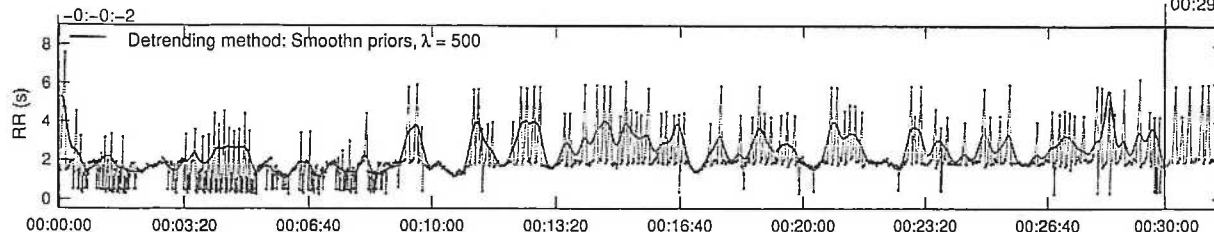
cameron baseline 3.txt - xx/xx/xx - xx:xx:xx

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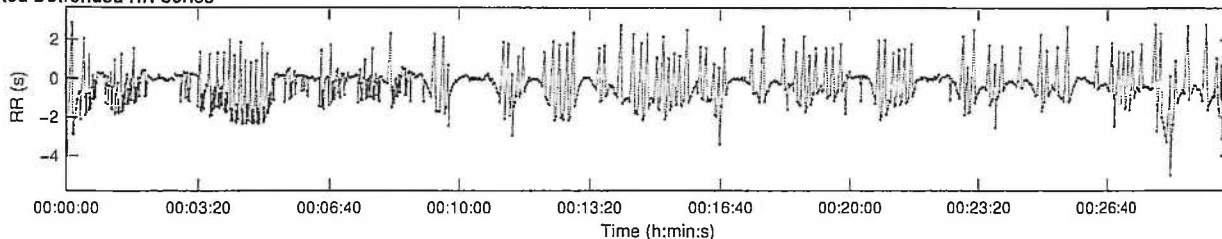
RR Interval Time Series

Results for a single sample

00:29:58



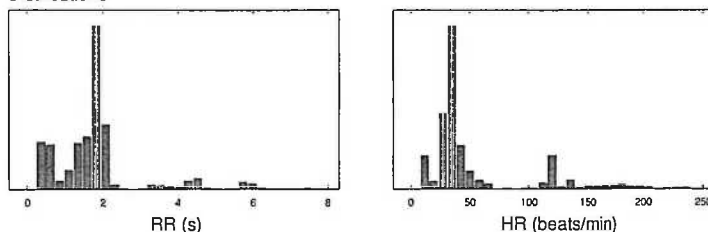
Selected Detrended RR Series



Time-Domain Results

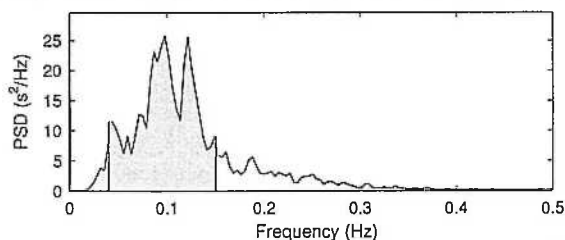
Variable	Units	Value
Mean RR*	(ms)	1766.5
STD RR (SDNN)	(ms)	1018.8
Mean HR*	(1/min)	53.18
STD HR	(1/min)	37.85
RMSSD	(ms)	1444.2
NN50	(count)	846
pNN50	(%)	83.2
RR triangular index		84.833
TINN	(ms)	2000.0

Distributions*



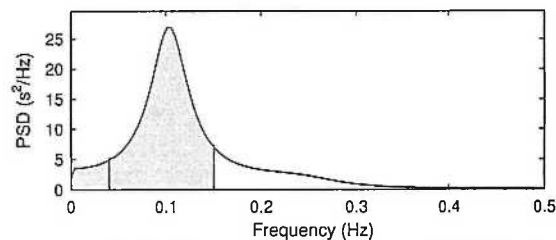
Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	66292	3.2	78.2
LF (0.04-0.15 Hz)	0.0977	1574835	75.7	21.8
HF (0.15-0.4 Hz)	0.1602	440020	21.1	
Total		2081409		
LF/HF		3.579		

AR Spectrum (AR model order = 16, not factorized)

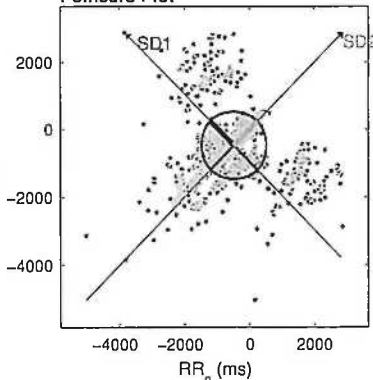


Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	152482	6.8	76.7
LF (0.04-0.15 Hz)	0.1016	1601455	71.5	23.2
HF (0.15-0.4 Hz)	0.1523	485059	21.7	
Total		2239437		
LF/HF		3.302		

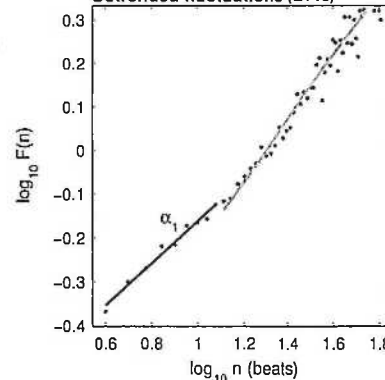
Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	1021.7
SD2	(ms)	1011.4
Recurrence plot		
Mean line length (Lmean)	(beats)	11.70
Max line length (Lmax)	(beats)	116
Recurrence rate (REC)	(%)	29.19
Determinism (DET)	(%)	98.06
Shannon Entropy (ShanEn)		3.277
Other		
Approximate entropy (ApEn)		0.927
Sample entropy (SampEn)		0.474
Detrended fluctuations (DFA): α1		0.480
Detrended fluctuations (DFA): α2		0.730
Correlation dimension (D2)		0.084
Multiscale entropy (MSE)		0.474 - 1.028

Poincare Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

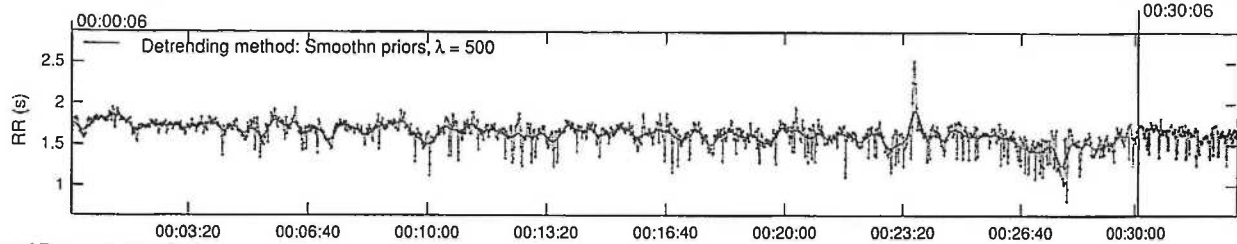
HRV Analysis Results

cameron loose hay day 1 08 11 16edittttted.txt - xx/xx/xx - xx:xx:xx

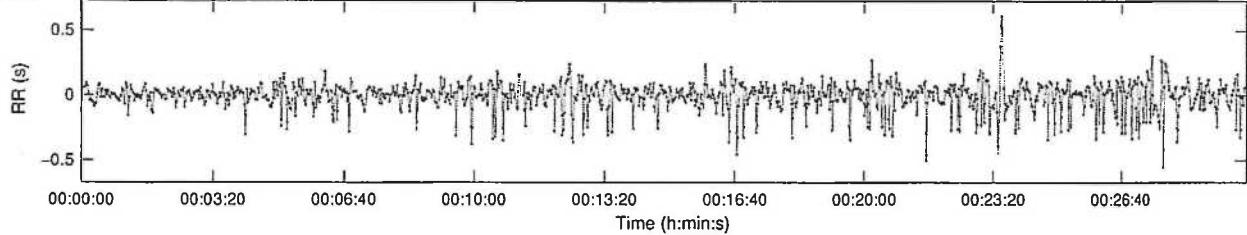
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RR Interval Time Series

Results for a single sample



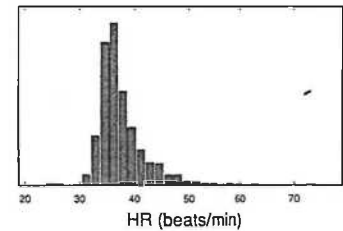
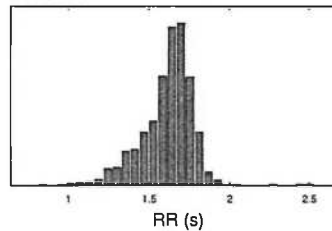
Selected Detrended RR Series



Time-Domain Results

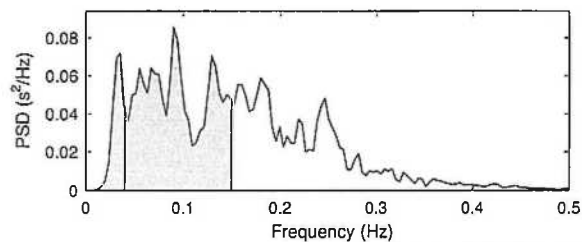
Variable	Units	Value
Mean RR*	(ms)	1614.8
STD RR (SDNN)	(ms)	118.4
Mean HR*	(1/min)	37.59
STD HR	(1/min)	3.63
RMSSD	(ms)	118.4
NN50	(count)	618
pNN50	(%)	49.6
RR triangular index		20.113
TINN	(ms)	815.0

Distributions*

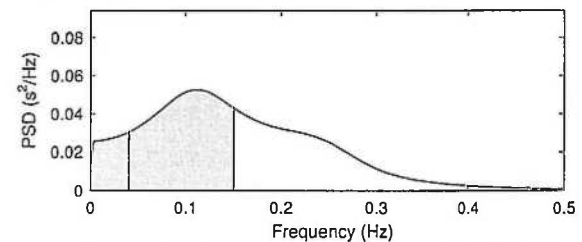


Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



AR Spectrum (AR model order = 16, not factorized)



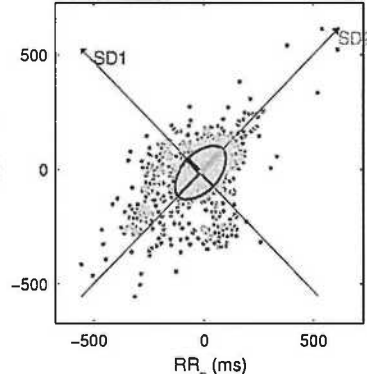
Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0352	930	7.8	
LF (0.04-0.15 Hz)	0.0898	5647	47.6	51.7
HF (0.15-0.4 Hz)	0.1797	5270	44.5	48.2
Total		11852		
LF/HF		1.072		

Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	1063	9.9	
LF (0.04-0.15 Hz)	0.1133	4928	45.9	51.0
HF (0.15-0.4 Hz)	0.1523	4738	44.1	49.0
Total		10734		
LF/HF		1.040		

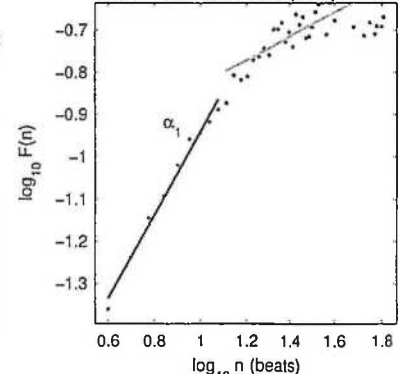
Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	83.7
SD2	(ms)	145.0
Recurrence plot		
Mean line length (Lmean)	(beats)	12.21
Max line length (Lmax)	(beats)	144
Recurrence rate (REC)	(%)	36.94
Determinism (DET)	(%)	98.93
Shannon Entropy (ShanEn)		3.339
Other		
Approximate entropy (ApEn)		1.359
Sample entropy (SampEn)		1.417
Detrended fluctuations (DFA): α1		0.986
Detrended fluctuations (DFA): α2		0.285
Correlation dimension (D2)		4.612
Multiscale entropy (MSE)		0.372 - 1.417

Poincare Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

HRV Analysis Results

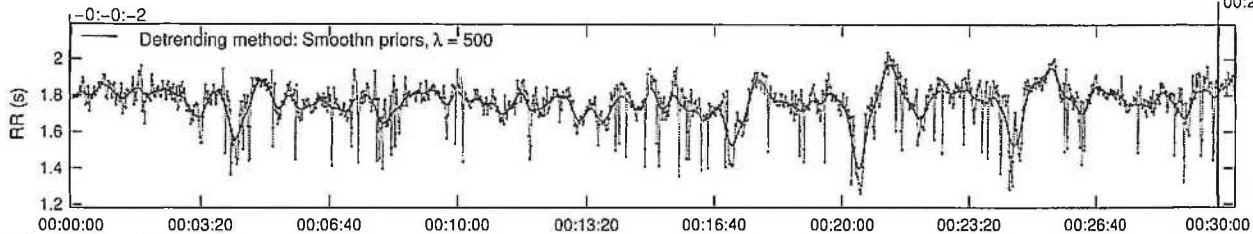
cameron loose hay day 10 16 11 16 (14).txt - xx/xx/xx - xx:xx:xx

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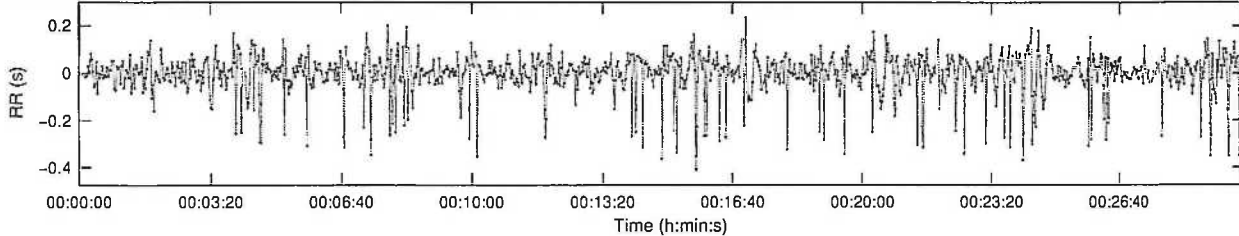
RR Interval Time Series

Results for a single sample

00:29:58



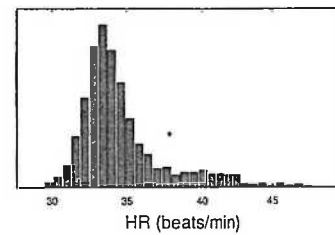
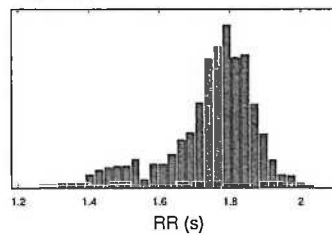
Selected Detrended RR Series



Time-Domain Results

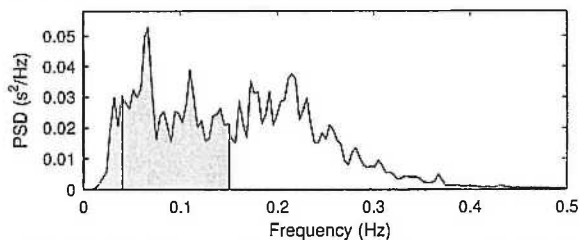
Variable	Units	Value
Mean RR*	(ms)	1743.0
STD RR (SDNN)	(ms)	96.9
Mean HR*	(1/min)	34.64
STD HR	(1/min)	2.72
RMSSD	(ms)	108.1
NN50	(count)	500
pNN50	(%)	45.4
RR triangular index		16.448
TINN	(ms)	470.0

Distributions*

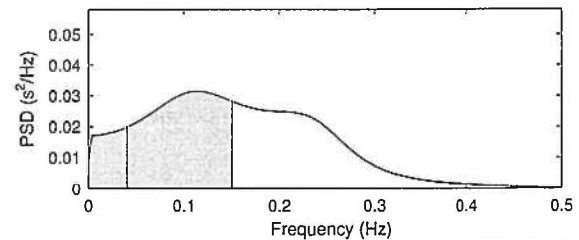


Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



AR Spectrum (AR model order = 16, not factorized)



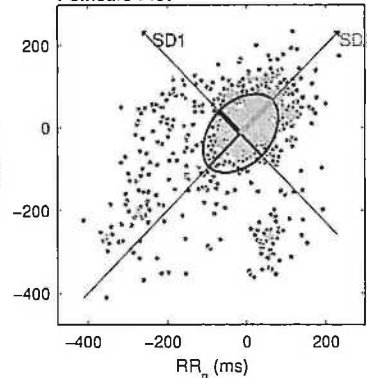
Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	405	6.0	45.7
LF (0.04-0.15 Hz)	0.0664	2928	43.0	47.0
HF (0.15-0.4 Hz)	0.2148	3478	51.0	53.0
Total		6813		
LF/HF		0.842		

Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	702	9.8	47.0
LF (0.04-0.15 Hz)	0.1133	3041	42.4	53.0
HF (0.15-0.4 Hz)	0.1523	3428	47.8	53.0
Total		7173		
LF/HF		0.887		

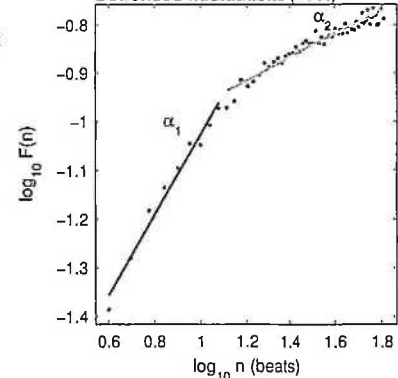
Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	76.5
SD2	(ms)	113.8
Recurrence plot		
Mean line length (Lmean)	(beats)	10.65
Max line length (Lmax)	(beats)	86
Recurrence rate (REC)	(%)	31.22
Determinism (DET)	(%)	98.30
Shannon Entropy (ShanEn)		3.169
Other		
Approximate entropy (ApEn)		1.374
Sample entropy (SampEn)		1.405
Detrended fluctuations (DFA): α1		0.828
Detrended fluctuations (DFA): α2		0.242
Correlation dimension (D2)		3.847
Multiscale entropy (MSE)		0.442 - 1.405

Poincare Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

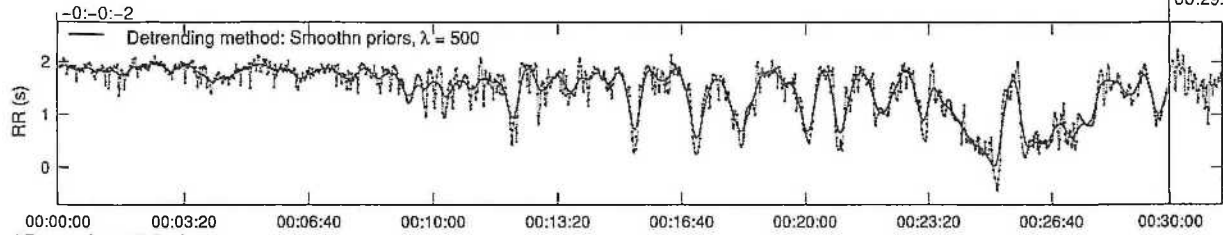
HRV Analysis Results

cameron loose hay day 21 28 11 16.txt - xx/xx/xx - xx:xx:xx

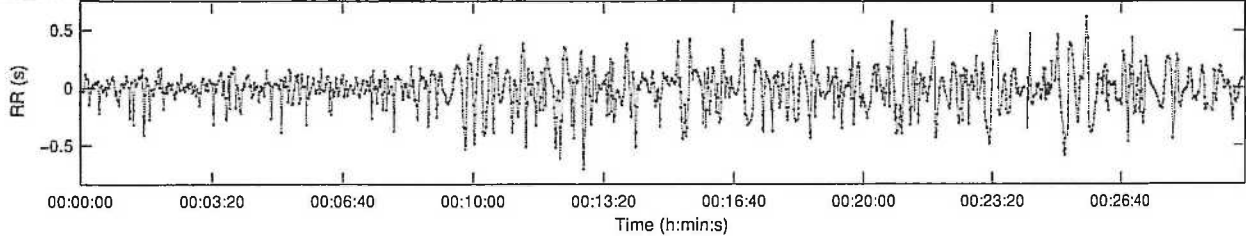
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RR Interval Time Series

Results for a single sample



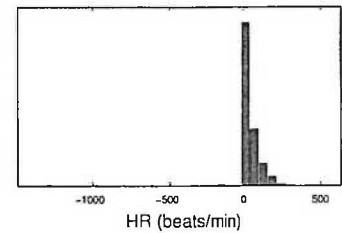
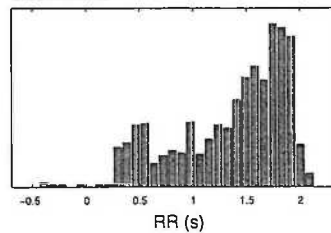
Selected Detrended RR Series



Time-Domain Results

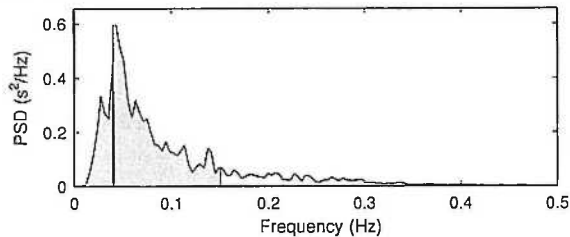
Variable	Units	Value
Mean RR*	(ms)	1353.0
STD RR (SDNN)	(ms)	183.3
Mean HR*	(1/min)	54.65
STD HR	(1/min)	60.23
RMSSD	(ms)	125.4
NN50	(count)	807
pNN50	(%)	58.0
RR triangular index		34.800
TINN	(ms)	985.0

Distributions*



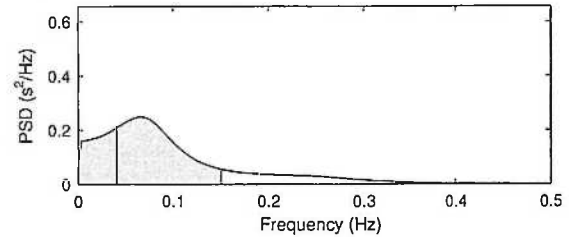
Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	6083	18.3	
LF (0.04-0.15 Hz)	0.0430	21576	64.9	79.5
HF (0.15-0.4 Hz)	0.1523	5566	16.7	20.5
Total		33231		
LF/HF		3.876		

AR Spectrum (AR model order = 16, not factorized)

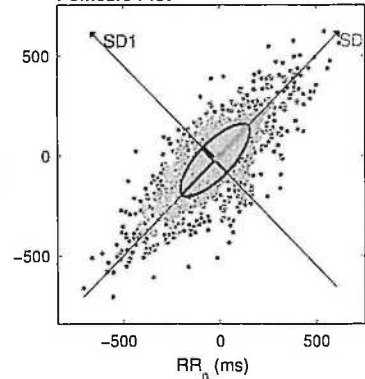


Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	6883	22.7	
LF (0.04-0.15 Hz)	0.0664	17882	59.0	76.4
HF (0.15-0.4 Hz)	0.1523	5526	18.2	23.6
Total		30297		
LF/HF		3.236		

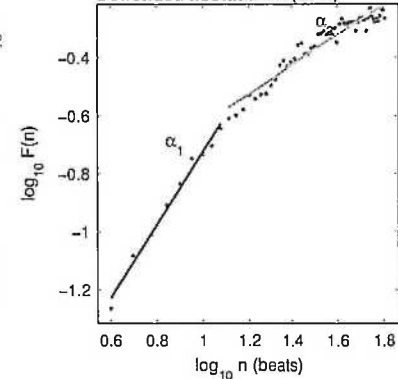
Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	88.7
SD2	(ms)	243.7
Recurrence plot		
Mean line length (Lmean)	(beats)	10.67
Max line length (Lmax)	(beats)	235
Recurrence rate (REC)	(%)	31.12
Determinism (DET)	(%)	98.33
Shannon Entropy (ShanEn)		3.185
Other		
Approximate entropy (ApEn)		1.301
Sample entropy (SampEn)		1.344
Detrended fluctuations (DFA): α1		1.257
Detrended fluctuations (DFA): α2		0.512
Correlation dimension (D2)		0.981
Multiscale entropy (MSE)		0.512 - 1.612

Poincare Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

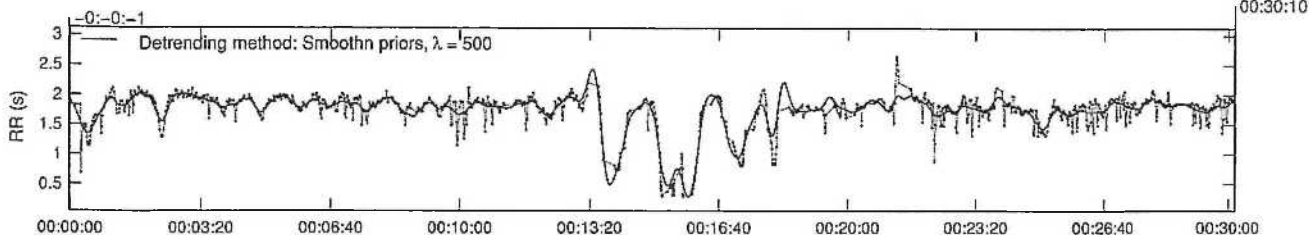
HRV Analysis Results

18 10 16 HR data CAMERON Haynet day 1.txt - xx/xx/xx - xx:xx:xx

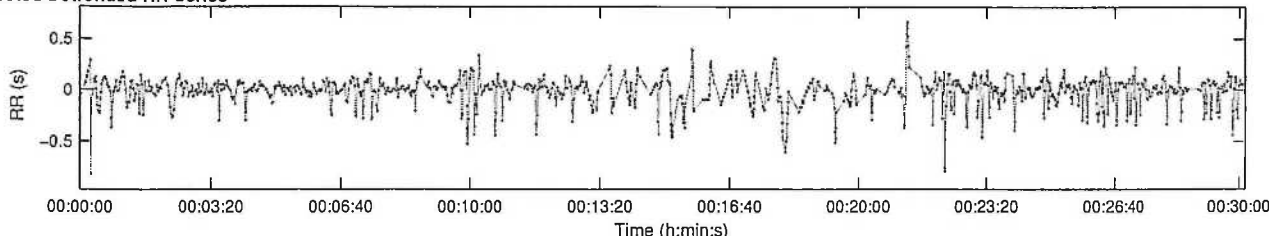
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RR Interval Time Series

Results for a single sample



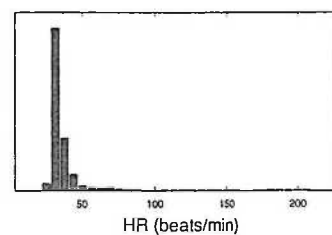
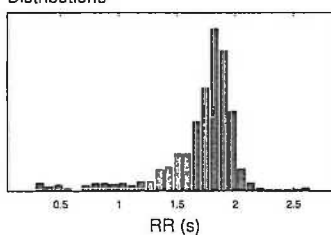
Selected Detrended RR Series



Time-Domain Results

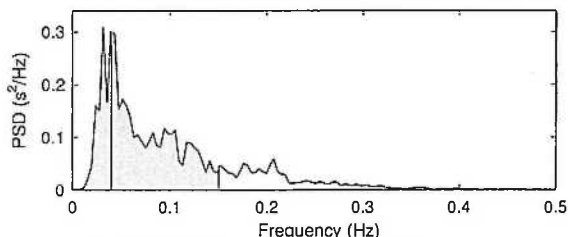
Variable	Units	Value
Mean RR*	(ms)	1697.5
STD RR (SDNN)	(ms)	157.7
Mean HR*	(1/min)	38.88
STD HR	(1/min)	15.09
RMSSD	(ms)	128.7
NN50	(count)	562
pNN50	(%)	52.3
RR triangular index		25.595
TINN	(ms)	1035.0

Distributions*



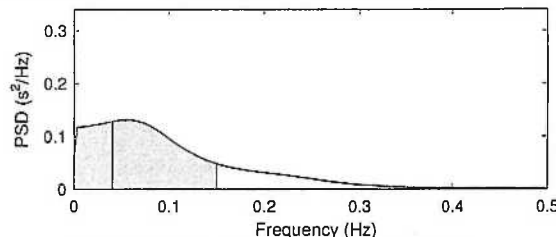
Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0313	4218	21.9	
LF (0.04-0.15 Hz)	0.0430	11069	57.5	73.6
HF (0.15-0.4 Hz)	0.2070	3963	20.6	26.4
Total		19255		
LF/HF		2.793		

AR Spectrum (AR model order = 16, not factorized)

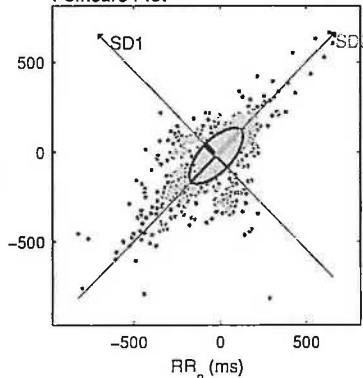


Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	4742	24.0	
LF (0.04-0.15 Hz)	0.0547	10724	54.4	71.6
HF (0.15-0.4 Hz)	0.1523	4250	21.6	28.4
Total		19720		
LF/HF		2.523		

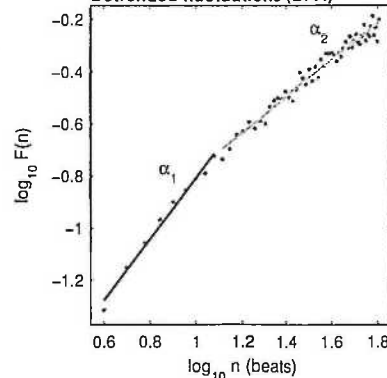
Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	91.1
SD2	(ms)	203.8
Recurrence plot		
Mean line length (Lmean)	(beats)	12.84
Max line length (Lmax)	(beats)	172
Recurrence rate (REC)	(%)	40.22
Determinism (DET)	(%)	98.96
Shannon Entropy (ShanEn)		3.386
Other		
Approximate entropy (ApEn)		1.253
Sample entropy (SampEn)		1.181
Detrended fluctuations (DFA): α1		1.183
Detrended fluctuations (DFA): α2		0.700
Correlation dimension (D2)		4.073
Multiscale entropy (MSE)		0.511 - 1.302

Poincare Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

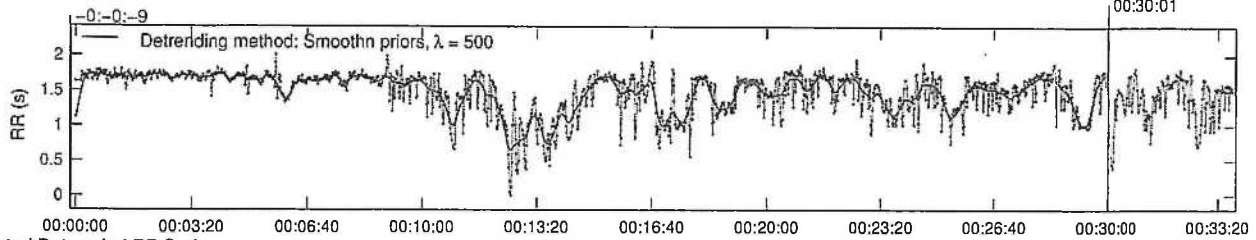
HRV Analysis Results

cameron haynet day 21 07 11 2016.txt - xx/xx/xx - xx:xx:xx

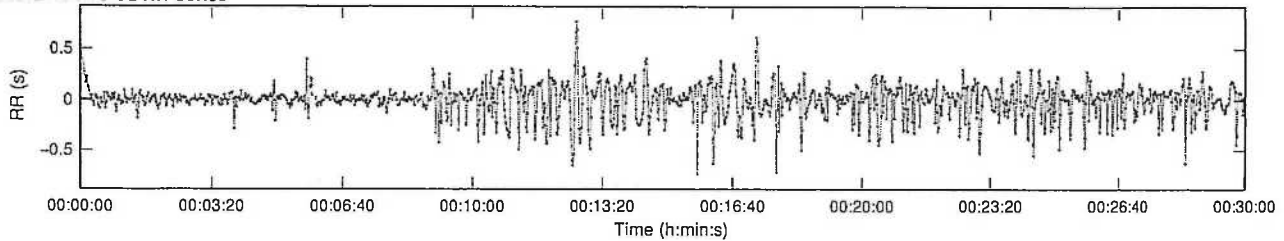
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RR Interval Time Series

Results for a single sample



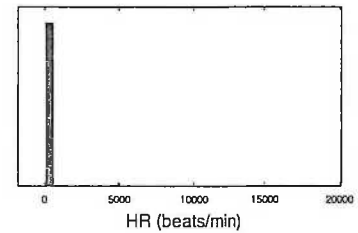
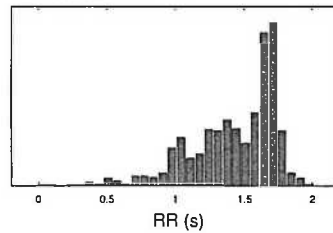
Selected Detrended RR Series



Time-Domain Results

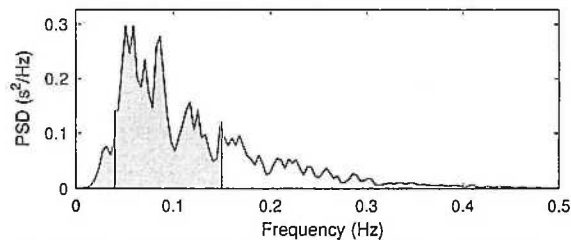
Variable	Units	Value
Mean RR*	(ms)	1436.2
STD RR (SDNN)	(ms)	169.2
Mean HR*	(1/min)	58.62
STD HR	(1/min)	477.94
RMSSD	(ms)	133.1
NN50	(count)	758
pNN50	(%)	53.2
RR triangular index		17.825
TINN	(ms)	1055.0

Distributions*

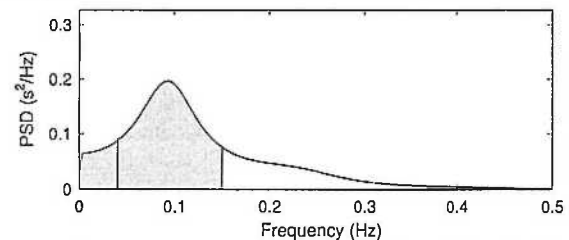


Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



AR Spectrum (AR model order = 16, not factorized)



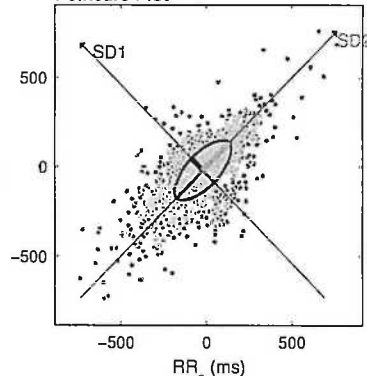
Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	1278	5.0	
LF (0.04-0.15 Hz)	0.0508	17275	67.3	70.9
HF (0.15-0.4 Hz)	0.1680	7098	27.7	29.1
Total		25656		
LF/HF		2.434		

Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	2800	11.2	
LF (0.04-0.15 Hz)	0.0938	15357	61.7	69.5
HF (0.15-0.4 Hz)	0.1523	6744	27.1	30.5
Total		24910		
LF/HF		2.277		

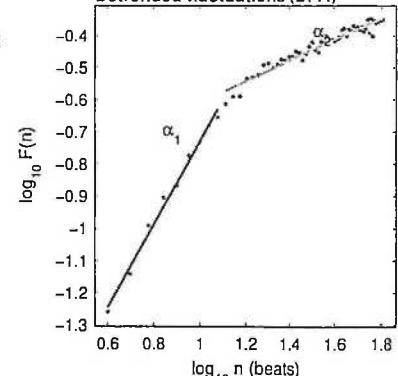
Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	94.1
SD2	(ms)	219.5
Recurrence plot		
Mean line length (Lmean)	(beats)	13.11
Max line length (Lmax)	(beats)	201
Recurrence rate (REC)	(%)	35.90
Determinism (DET)	(%)	98.81
Shannon Entropy (ShanEn)		3.269
Other		
Approximate entropy (ApEn)		1.075
Sample entropy (SampEn)		0.869
Detrended fluctuations (DFA): α1		1.287
Detrended fluctuations (DFA): α2		0.331
Correlation dimension (D2)		3.713
Multiscale entropy (MSE)		0.448 - 0.887

Poincare Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

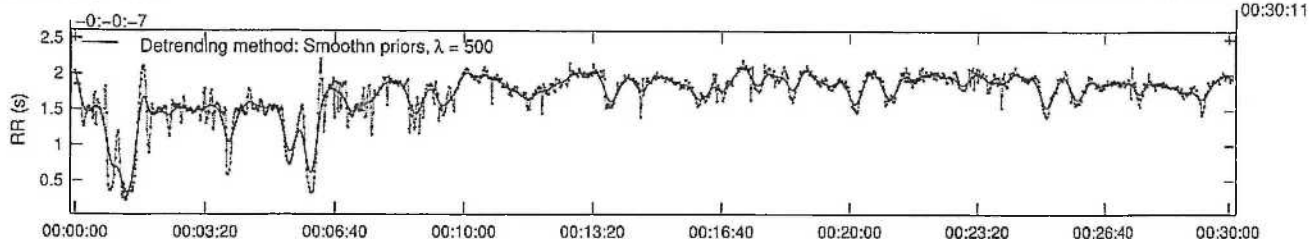
HRV Analysis Results

DATA 10 CAMERON HAYNET 26 10 16.txt - xx/xx/xx - xx:xx:xx

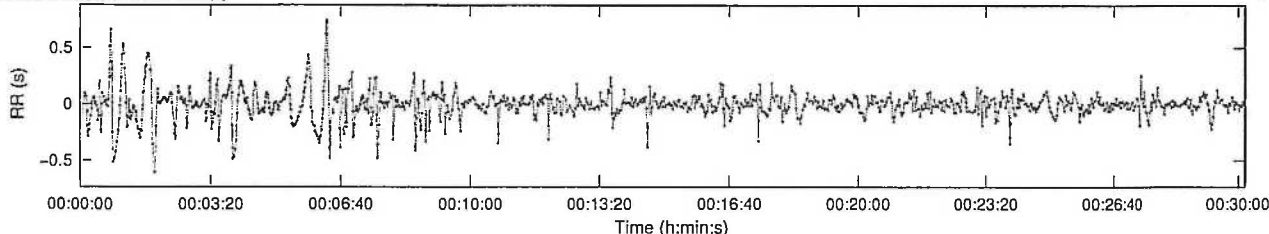
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RR Interval Time Series

Results for a single sample



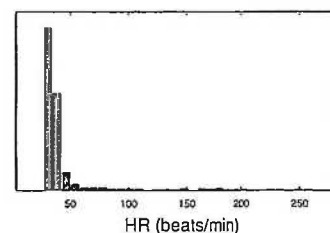
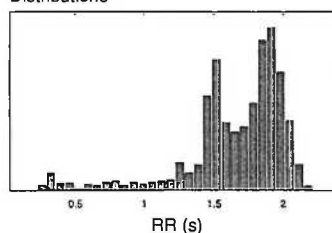
Selected Detrended RR Series



Time-Domain Results

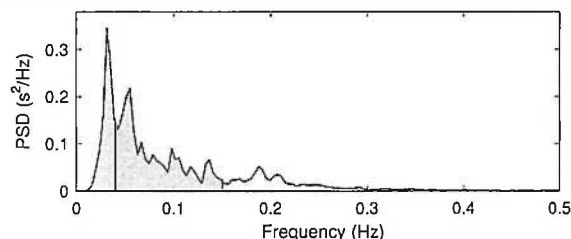
Variable	Units	Value
Mean RR*	(ms)	1650.1
STD RR (SDNN)	(ms)	142.0
Mean HR*	(1/min)	41.37
STD HR	(1/min)	18.51
RMSSD	(ms)	95.4
NN50	(count)	502
pNN50	(%)	42.4
RR triangular index		18.531
TINN	(ms)	930.0

Distributions*



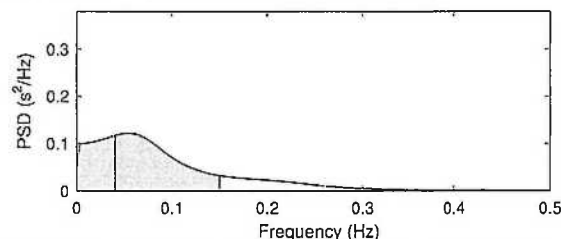
Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0313	4018	26.4	
LF (0.04-0.15 Hz)	0.0547	8308	54.6	74.2
HF (0.15-0.4 Hz)	0.1875	2877	18.9	25.7
Total		15208		
LF/HF		2.888		

AR Spectrum (AR model order = 16, not factorized)

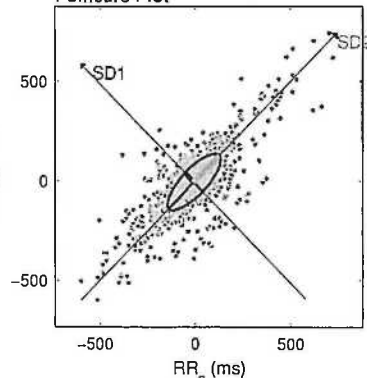


Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	4131	26.3	
LF (0.04-0.15 Hz)	0.0547	8712	55.4	75.2
HF (0.15-0.4 Hz)	0.1523	2874	18.3	24.8
Total		15721		
LF/HF		3.031		

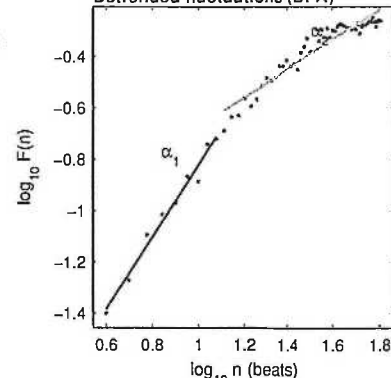
Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	67.5
SD2	(ms)	189.2
Recurrence plot		
Mean line length (Lmean)	(beats)	19.01
Max line length (Lmax)	(beats)	276
Recurrence rate (REC)	(%)	48.63
Determinism (DET)	(%)	99.39
Shannon Entropy (ShanEn)		3.755
Other		
Approximate entropy (ApEn)		1.156
Sample entropy (SampEn)		1.051
Detrended fluctuations (DFA): α1		1.403
Detrended fluctuations (DFA): α2		0.568
Correlation dimension (D2)		4.007
Multiscale entropy (MSE)		0.363 - 1.119

Poincare Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

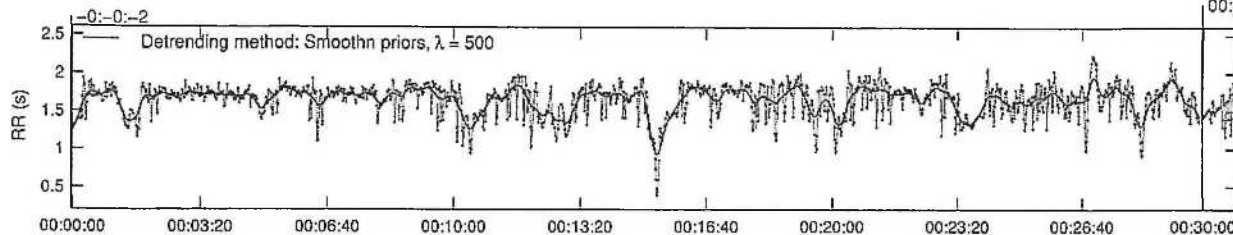
HRV Analysis Results

cameron slow feeder normal day 1.txt - xx/xx/xx - xx:xx:xx

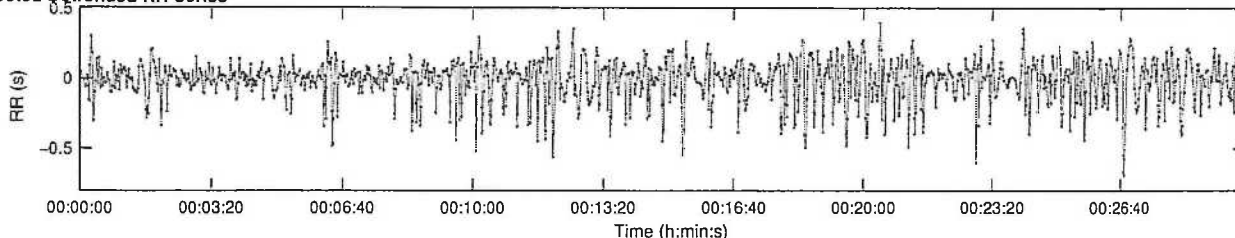
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RR Interval Time Series

Results for a single sample



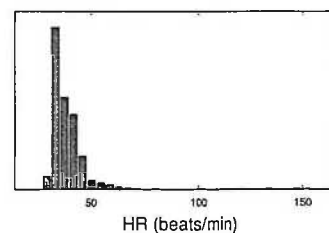
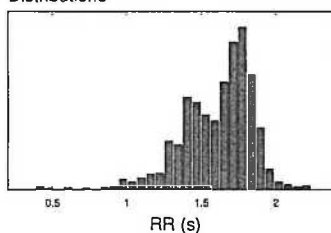
Selected Detrended RR Series



Time-Domain Results

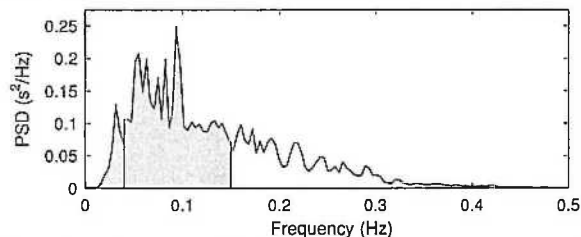
Variable	Units	Value
Mean RR*	(ms)	1611.3
STD RR (SDNN)	(ms)	159.1
Mean HR*	(1/min)	38.37
STD HR	(1/min)	7.85
RMSSD	(ms)	146.0
NN50	(count)	790
pNN50	(%)	62.9
RR triangular index		32.231
TINN	(ms)	820.0

Distributions*



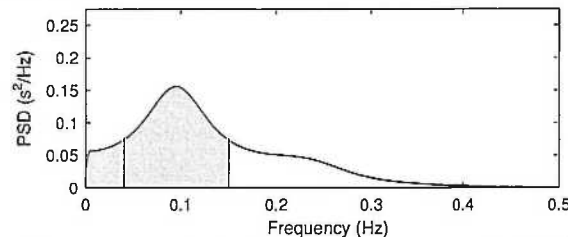
Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0313	1505	6.5	
LF (0.04-0.15 Hz)	0.0938	13925	59.9	64.1
HF (0.15-0.4 Hz)	0.1602	7795	33.6	35.9
Total		23229		
LF/HF		1.786		

AR Spectrum (AR model order = 16, not factorized)

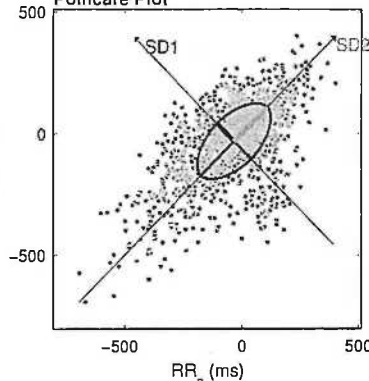


Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	2407	10.7	
LF (0.04-0.15 Hz)	0.0938	12823	57.1	64.0
HF (0.15-0.4 Hz)	0.1523	7223	32.2	36.0
Total		22458		
LF/HF		1.775		

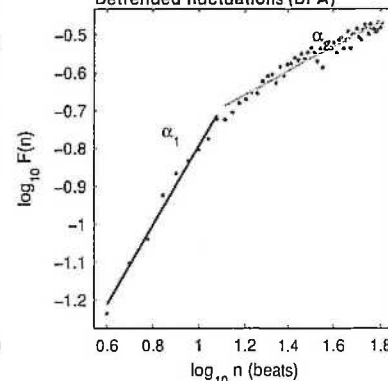
Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	103.3
SD2	(ms)	199.9
Recurrence plot		
Mean line length (Lmean)	(beats)	10.33
Max line length (Lmax)	(beats)	135
Recurrence rate (REC)	(%)	28.96
Determinism (DET)	(%)	98.22
Shannon Entropy (ShanEn)		3.135
Other		
Approximate entropy (ApEn)		1.359
Sample entropy (SampEn)		1.345
Detrended fluctuations (DFA): α1		1.048
Detrended fluctuations (DFA): α2		0.319
Correlation dimension (D2)		3.750
Multiscale entropy (MSE)		0.633 - 1.355

Poincare Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

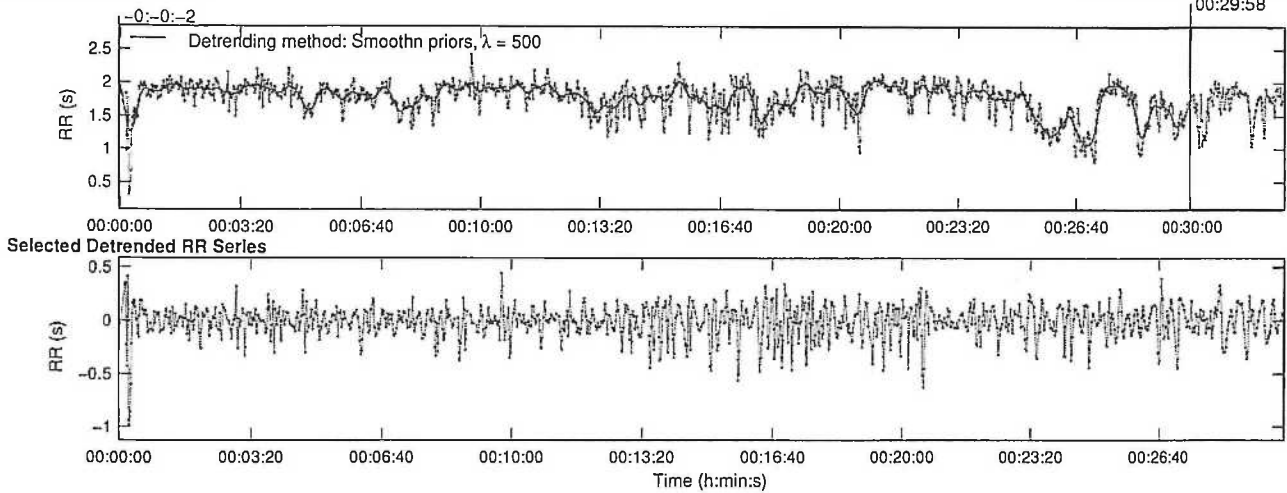
HRV Analysis Results

cameron slow feeder normal grid day 2.txt - xx/xx/xx - xx:xx:xx

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RR Interval Time Series

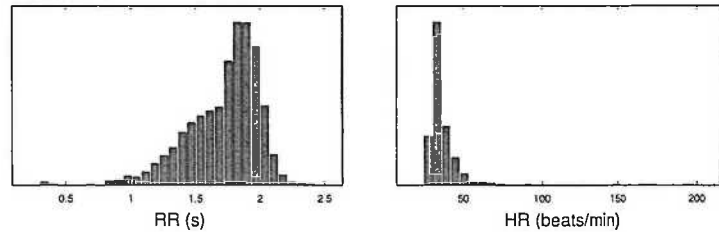
Results for a single sample



Time-Domain Results

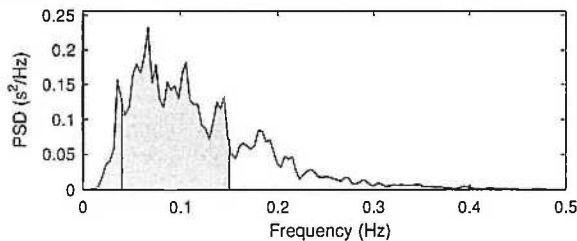
Variable	Units	Value
Mean RR*	(ms)	1719.7
STD RR (SDNN)	(ms)	162.5
Mean HR*	(1/min)	36.30
STD HR	(1/min)	9.07
RMSSD	(ms)	141.9
NN50	(count)	761
pNN50	(%)	65.5
RR triangular index		32.306
TINN	(ms)	1045.0

Distributions*



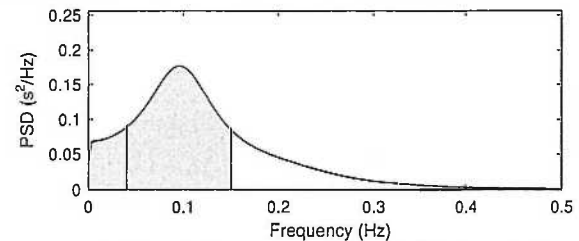
Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



Frequency Band	Peak (Hz)	Power (ms^2)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0352	1599	7.2	
LF (0.04-0.15 Hz)	0.0664	15056	67.5	72.7
HF (0.15-0.4 Hz)	0.1797	5660	25.4	27.3
Total		22321		
LF/HF		2.660		

AR Spectrum (AR model order = 16, not factorized)

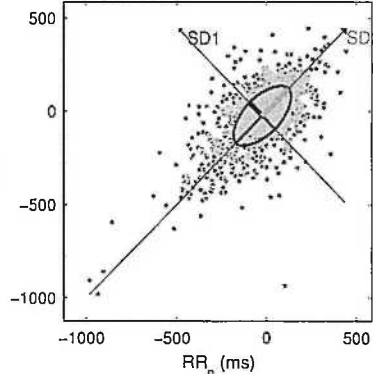


Frequency Band	Peak (Hz)	Power (ms^2)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	2925	12.1	
LF (0.04-0.15 Hz)	0.0977	14852	61.4	69.9
HF (0.15-0.4 Hz)	0.1523	6386	26.4	30.1
Total		24169		
LF/HF		2.326		

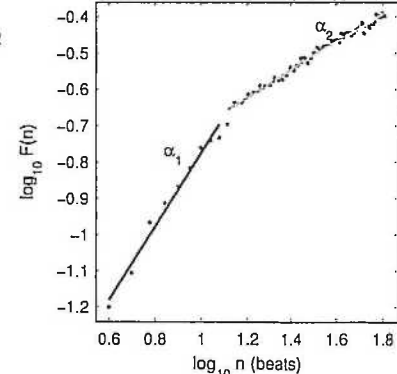
Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	100.4
SD2	(ms)	206.8
Recurrence plot		
Mean line length (Lmean)	(beats)	10.58
Max line length (Lmax)	(beats)	119
Recurrence rate (REC)	(%)	33.11
Determinism (DET)	(%)	97.99
Shannon Entropy (ShanEn)		3.187
Other		
Approximate entropy (ApEn)		1.371
Sample entropy (SampEn)		1.459
Detrended fluctuations (DFA): α_1		1.014
Detrended fluctuations (DFA): α_2		0.385
Correlation dimension (D2)		1.594
Multiscale entropy (MSE)		0.523 - 1.578

Poincare Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

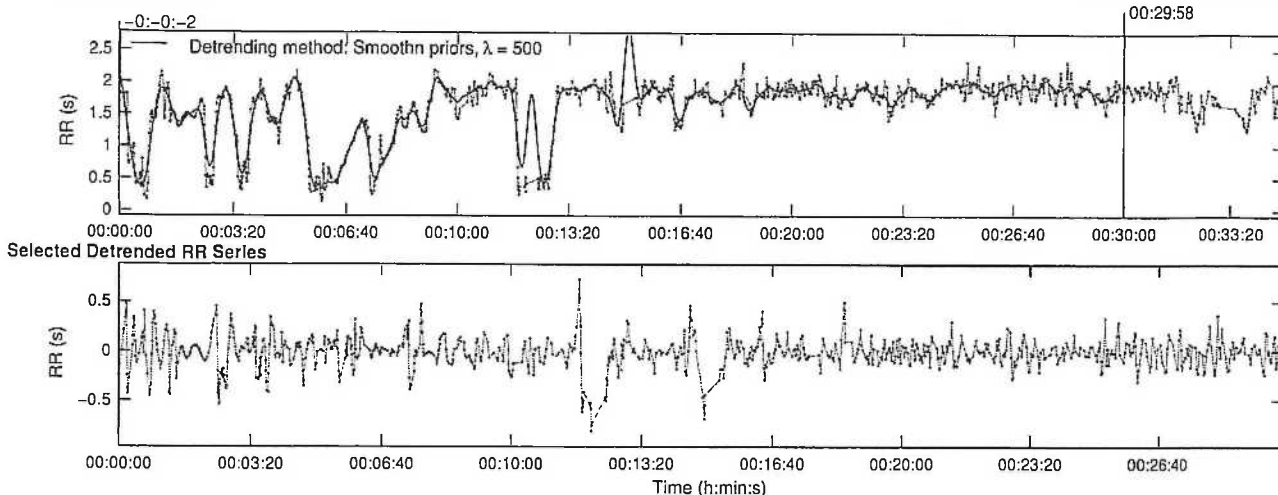
HRV Analysis Results

cameron normal grid 3.txt - xx/xx/xx - xx:xx:xx

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RR Interval Time Series

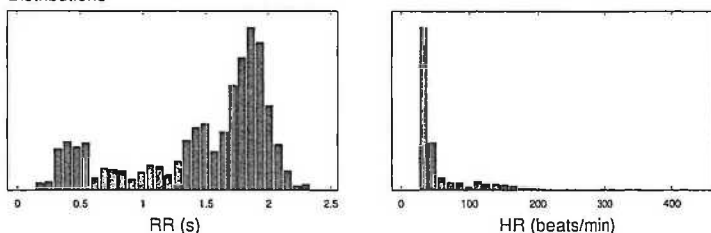
Results for a single sample



Time-Domain Results

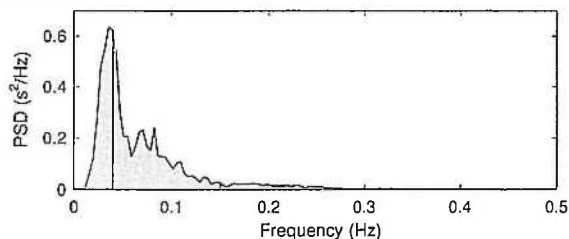
Variable	Units	Value
Mean RR*	(ms)	1469.6
STD RR (SDNN)	(ms)	176.6
Mean HR*	(1/min)	55.52
STD HR	(1/min)	33.76
RMSSD	(ms)	116.5
NN50	(count)	572
pNN50	(%)	57.6
RR triangular index		31.063
TINN	(ms)	1095.0

Distributions*



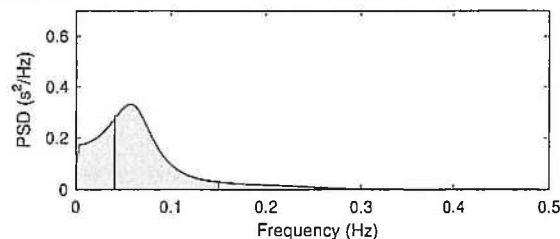
Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



Frequency Band	Peak (Hz)	Power (ms^2)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0352	10070	36.9	
LF (0.04-0.15 Hz)	0.0430	15260	55.9	88.6
HF (0.15-0.4 Hz)	0.1641	1964	7.2	11.4
Total		27296		
LF/HF		7.768		

AR Spectrum (AR model order = 16, not factorized)

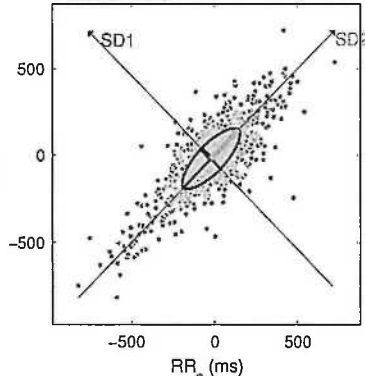


Frequency Band	Peak (Hz)	Power (ms^2)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	8018	29.3	
LF (0.04-0.15 Hz)	0.0586	17139	62.7	88.8
HF (0.15-0.4 Hz)	0.1523	2165	7.9	11.2
Total		27323		
LF/HF		7.917		

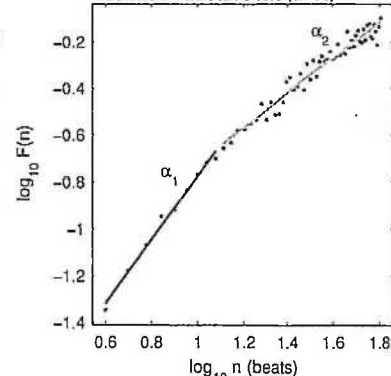
Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	82.4
SD2	(ms)	235.6
Recurrence plot		
Mean line length (Lmean)	(beats)	16.07
Max line length (Lmax)	(beats)	383
Recurrence rate (REC)	(%)	45.52
Determinism (DET)	(%)	99.20
Shannon Entropy (ShanEn)		3.650
Other		
Approximate entropy (ApEn)		1.289
Sample entropy (SampEn)		1.215
Detrended fluctuations (DFA): α_1		1.361
Detrended fluctuations (DFA): α_2		0.754
Correlation dimension (D2)		3.553
Multiscale entropy (MSE)		0.627 - 1.403

Poincare Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

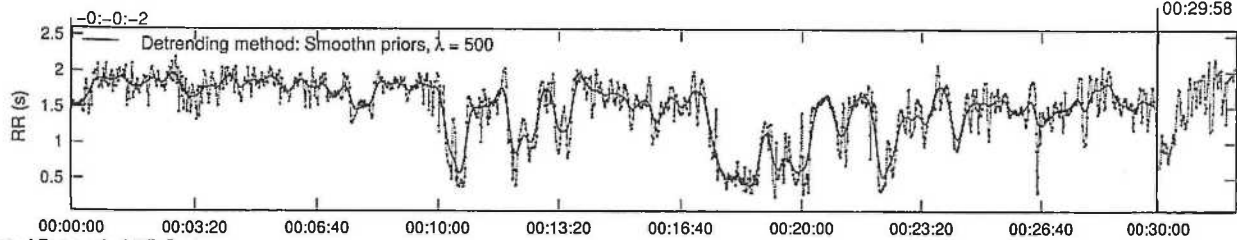
HRV Analysis Results

CAMERON GREEDY GRID 1.txt - xx/xx/xx - xx:xx:xx

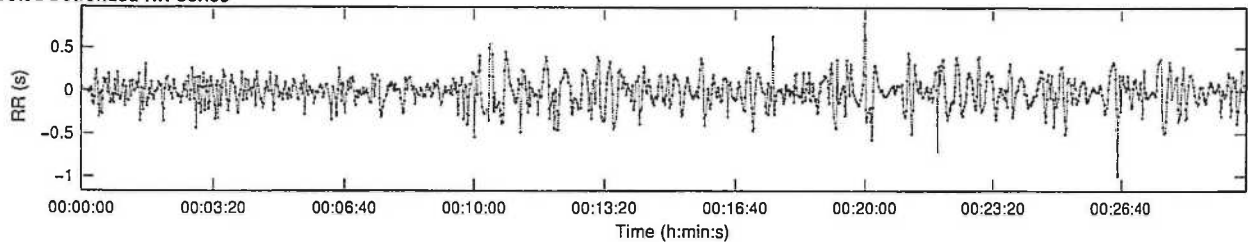
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RR Interval Time Series

Results for a single sample



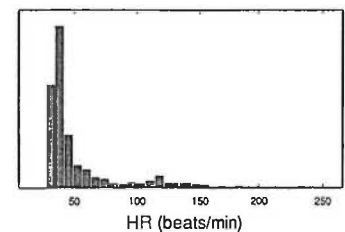
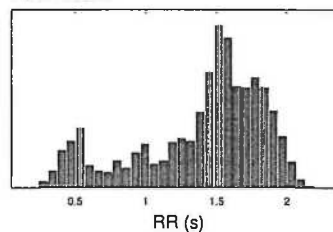
Selected Detrended RR Series



Time-Domain Results

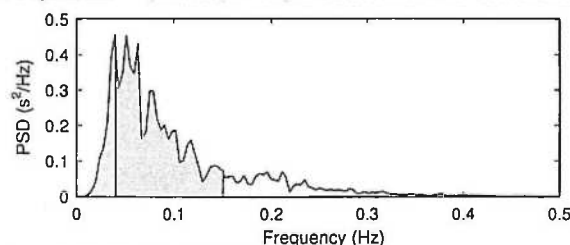
Variable	Units	Value
Mean RR*	(ms)	1395.4
STD RR (SDNN)	(ms)	183.2
Mean HR*	(1/min)	52.19
STD HR	(1/min)	21.25
RMSSD	(ms)	134.5
NN50	(count)	819
pNN50	(%)	59.2
RR triangular index		39.571
TINN	(ms)	1275.0

Distributions*



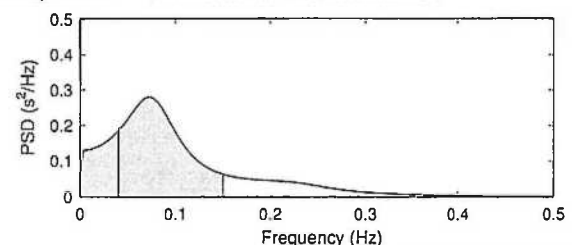
Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	4854	14.9	
LF (0.04-0.15 Hz)	0.0508	21850	66.9	78.6
HF (0.15-0.4 Hz)	0.2109	5950	18.2	21.4
Total		32665		
LF/HF		3.672		

AR Spectrum (AR model order = 16, not factorized)

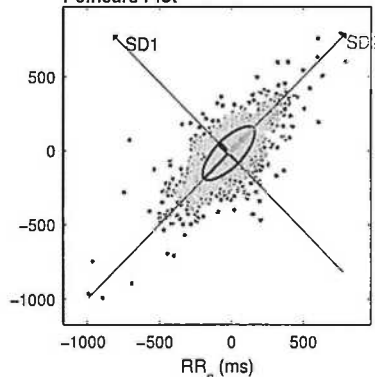


Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	5758	18.2	
LF (0.04-0.15 Hz)	0.0742	19716	62.3	76.2
HF (0.15-0.4 Hz)	0.1523	6153	19.5	23.8
Total		31634		
LF/HF		3.204		

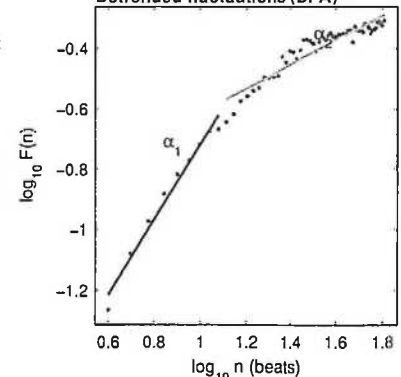
Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	95.2
SD2	(ms)	240.8
Recurrence plot		
Mean line length (Lmean)	(beats)	10.87
Max line length (Lmax)	(beats)	114
Recurrence rate (REC)	(%)	32.01
Determinism (DET)	(%)	98.32
Shannon Entropy (ShanEn)		3.227
Other		
Approximate entropy (ApEn)		1.319
Sample entropy (SampEn)		1.309
Detrended fluctuations (DFA): α1		1.240
Detrended fluctuations (DFA): α2		0.401
Correlation dimension (D2)		3.557
Multiscale entropy (MSE)		0.467 - 1.571

Poincare Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

HRV Analysis Results

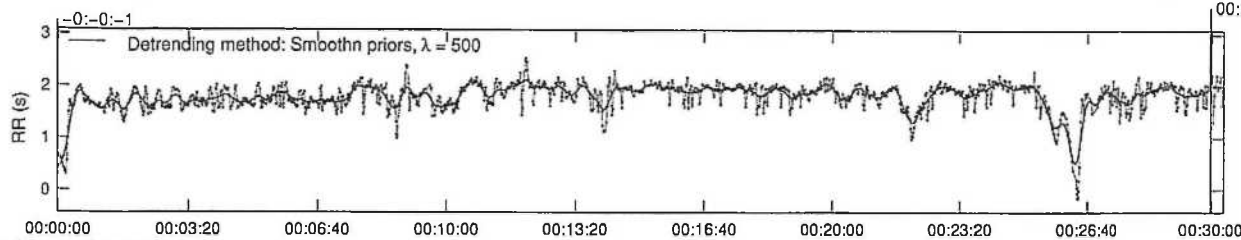
Cameron greedy grid 2.txt - xx/xx/xx - xx:xx:xx

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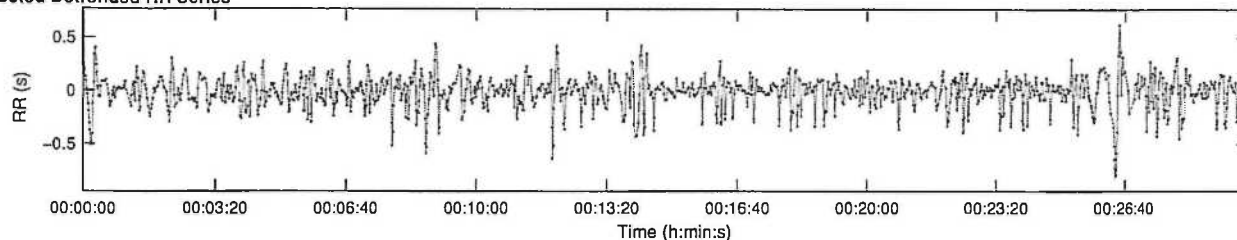
RR Interval Time Series

Results for a single sample

00:29:58



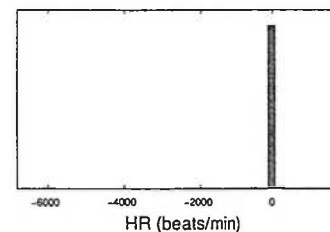
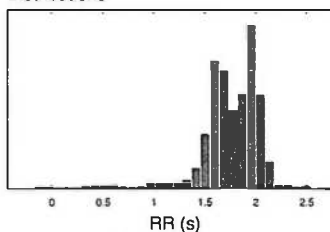
Selected Detrended RR Series



Time-Domain Results

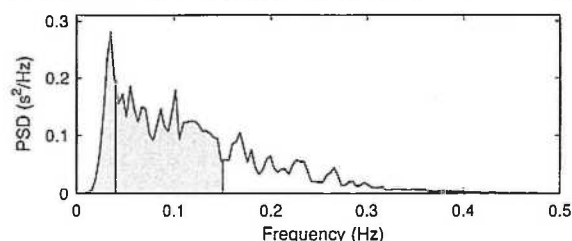
Variable	Units	Value
Mean RR*	(ms)	1744.8
STD RR (SDNN)	(ms)	158.4
Mean HR*	(1/min)	29.90
STD HR	(1/min)	184.97
RMSSD	(ms)	137.9
NN50	(count)	709
pNN50	(%)	60.6
RR triangular index		28.561
TINN	(ms)	1015.0

Distributions*



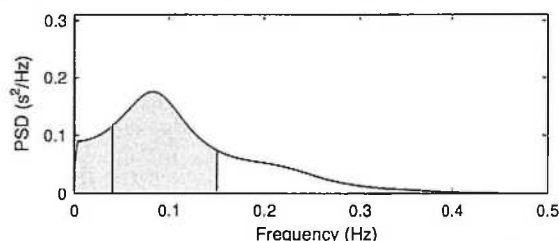
Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0352	3504	14.5	
LF (0.04-0.15 Hz)	0.0547	13808	57.0	66.6
HF (0.15-0.4 Hz)	0.1680	6916	28.5	33.4
Total		24234		
LF/HF		1.996		

AR Spectrum (AR model order = 16, not factorized)

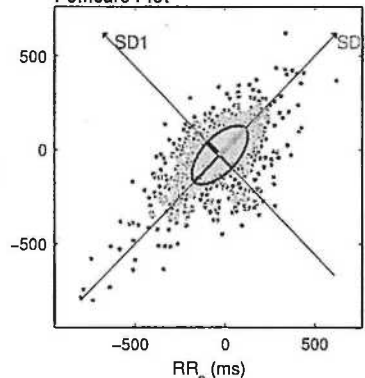


Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	3813	15.0	
LF (0.04-0.15 Hz)	0.0820	14790	58.2	68.5
HF (0.15-0.4 Hz)	0.1523	6789	26.7	31.5
Total		25397		
LF/HF		2.179		

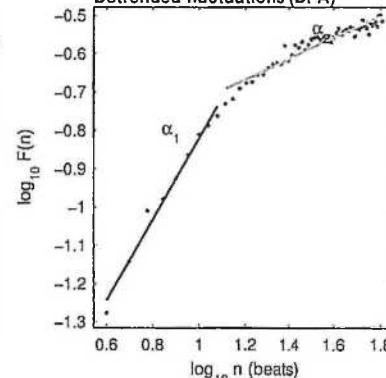
Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	97.5
SD2	(ms)	201.7
Recurrence plot		
Mean line length (Lmean)	(beats)	9.78
Max line length (Lmax)	(beats)	77
Recurrence rate (REC)	(%)	30.71
Determinism (DET)	(%)	98.01
Shannon Entropy (ShanEn)		3.100
Other		
Approximate entropy (ApEn)		1.341
Sample entropy (SampEn)		1.409
Detrended fluctuations (DFA): α_1		1.058
Detrended fluctuations (DFA): α_2		0.277
Correlation dimension (D2)		4.095
Multiscale entropy (MSE)		0.437 - 1.489

Poincare Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

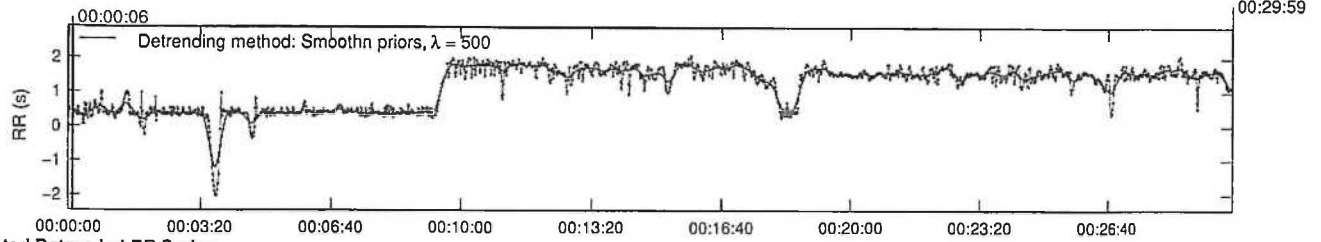
HRV Analysis Results

cameron sf greedy grid day 14.txt - xx/xx/xx - xx:xx:xx

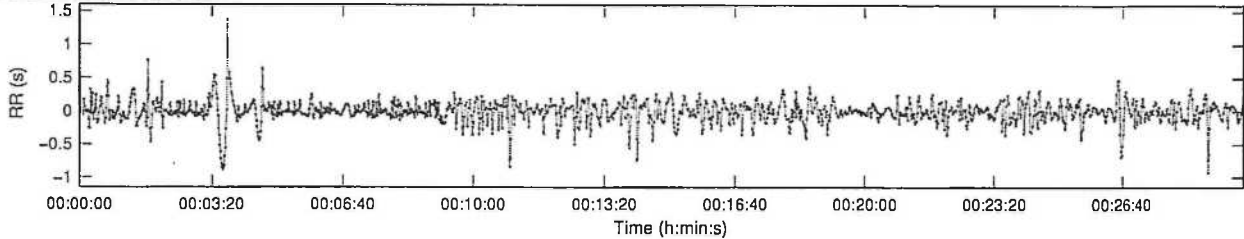
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RR Interval Time Series

Results for a single sample



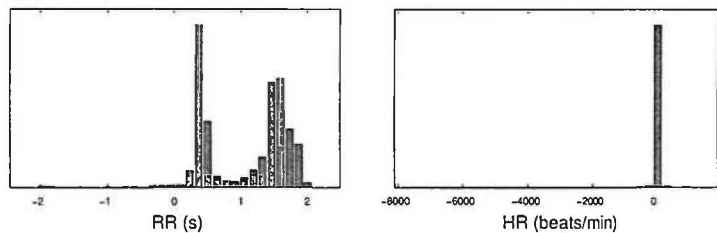
Selected Detrended RR Series



Time-Domain Results

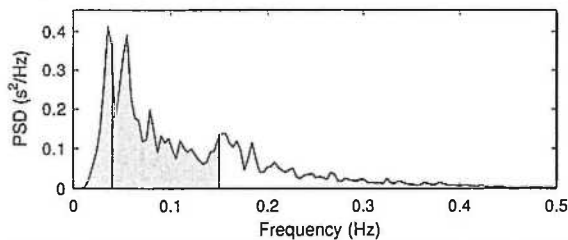
Variable	Units	Value
Mean RR*	(ms)	1045.2
STD RR (SDNN)	(ms)	171.6
Mean HR*	(1/min)	75.80
STD HR	(1/min)	223.93
RMSSD	(ms)	118.9
NN50	(count)	864
pNN50	(%)	50.7
RR triangular index		27.500
TINN	(ms)	1565.0

Distributions*



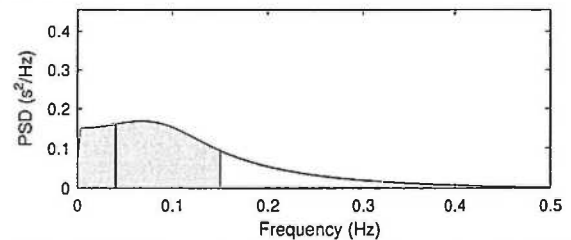
Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0352	4977	16.7	
LF (0.04-0.15 Hz)	0.0547	15858	53.3	64.0
HF (0.15-0.4 Hz)	0.1563	8924	30.0	36.0
Total		29770		
LF/HF		1.777		

AR Spectrum (AR model order = 16, not factorized)

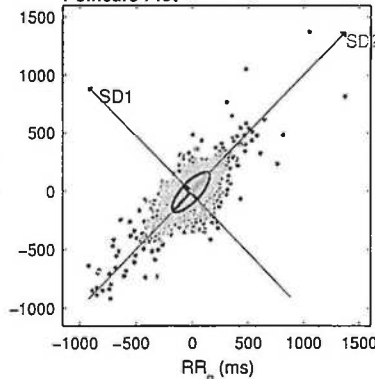


Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	6045	20.1	
LF (0.04-0.15 Hz)	0.0664	16029	53.2	66.6
HF (0.15-0.4 Hz)	0.1523	8039	26.7	33.4
Total		30126		
LF/HF		1.994		

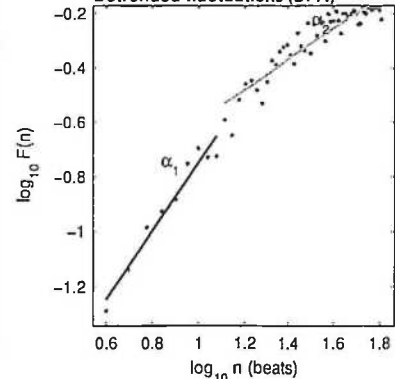
Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	84.1
SD2	(ms)	227.5
Recurrence plot		
Mean line length (Lmean)	(beats)	18.91
Max line length (Lmax)	(beats)	356
Recurrence rate (REC)	(%)	52.49
Determinism (DET)	(%)	99.30
Shannon Entropy (ShanEn)		3.657
Other		
Approximate entropy (ApEn)		1.082
Sample entropy (SampEn)		0.845
Detrended fluctuations (DFA): α1		1.246
Detrended fluctuations (DFA): α2		0.564
Correlation dimension (D2)		3.595
Multiscale entropy (MSE)		0.329 - 1.251

Poincare Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

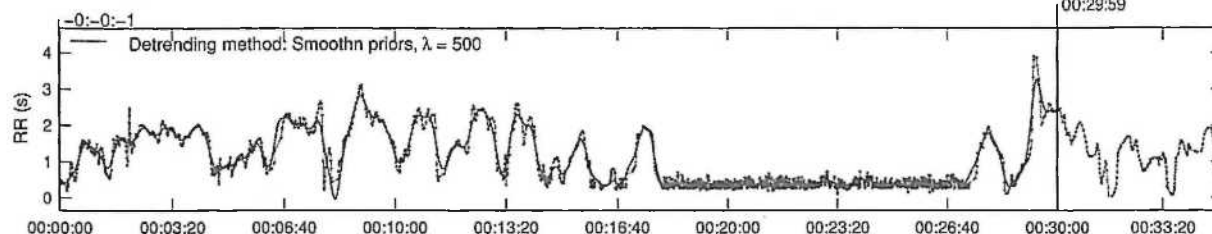
HRV Analysis Results

helga baseline 1.txt - xx/xx/xx - xx:xx:xx

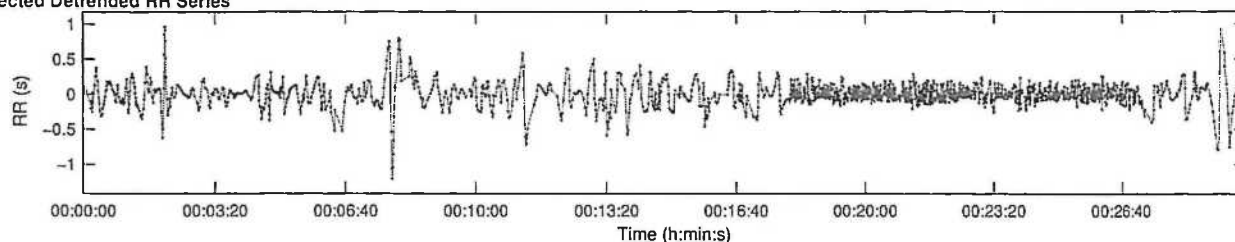
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RR Interval Time Series

Results for a single sample



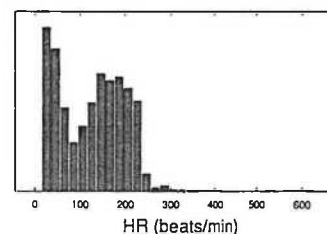
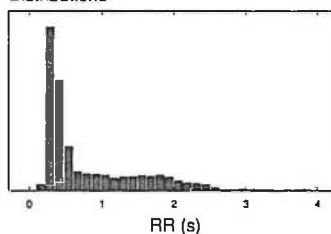
Selected Detrended RR Series



Time-Domain Results

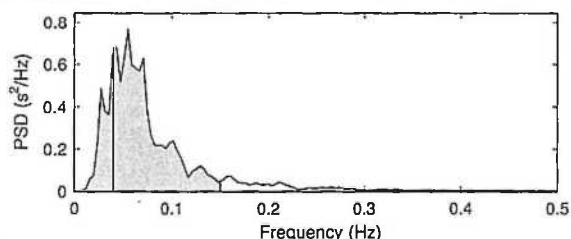
Variable	Units	Value
Mean RR*	(ms)	793.8
STD RR (SDNN)	(ms)	173.0
Mean HR*	(1/min)	126.64
STD HR	(1/min)	44.80
RMSSD	(ms)	104.0
NN50	(count)	1159
pNN50	(%)	56.8
RR triangular index		28.775
TINN	(ms)	1480.0

Distributions*



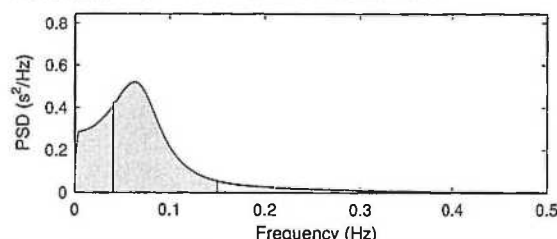
Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	8105	17.9	
LF (0.04-0.15 Hz)	0.0547	32458	71.6	87.2
HF (0.15-0.4 Hz)	0.1602	4743	10.5	12.7
Total		45313		
LF/HF		6.844		

AR Spectrum (AR model order = 16, not factorized)

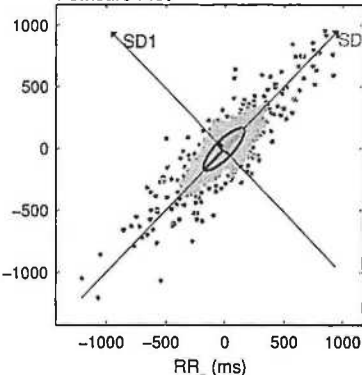


Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	12678	26.6	
LF (0.04-0.15 Hz)	0.0625	30773	64.6	88.1
HF (0.15-0.4 Hz)	0.1523	4143	8.7	11.9
Total		47601		
LF/HF		7.429		

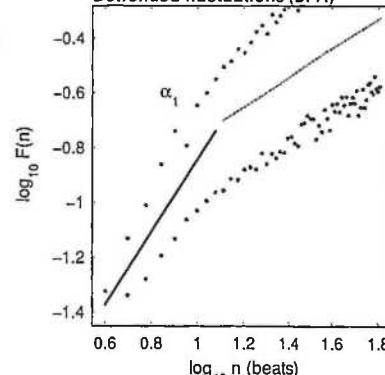
Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	73.6
SD2	(ms)	233.3
Recurrence plot		
Mean line length (Lmean)	(beats)	12.40
Max line length (Lmax)	(beats)	288
Recurrence rate (REC)	(%)	37.38
Determinism (DET)	(%)	98.14
Shannon Entropy (ShanEn)		3.304
Other		
Approximate entropy (ApEn)		1.285
Sample entropy (SampEn)		1.372
Detrended fluctuations (DFA): α ₁		1.327
Detrended fluctuations (DFA): α ₂		0.538
Correlation dimension (D2)		4.355
Multiscale entropy (MSE)		0.728 - 1.554

Poincare Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

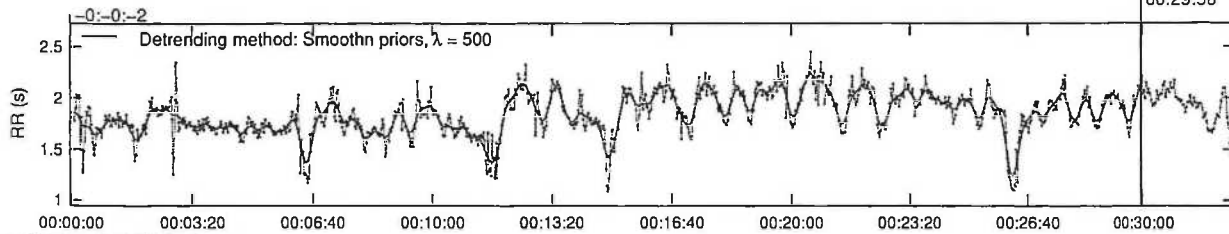
HRV Analysis Results

HELGA BASELINE 2.txt - xx/xx/xx - xx:xx:xx

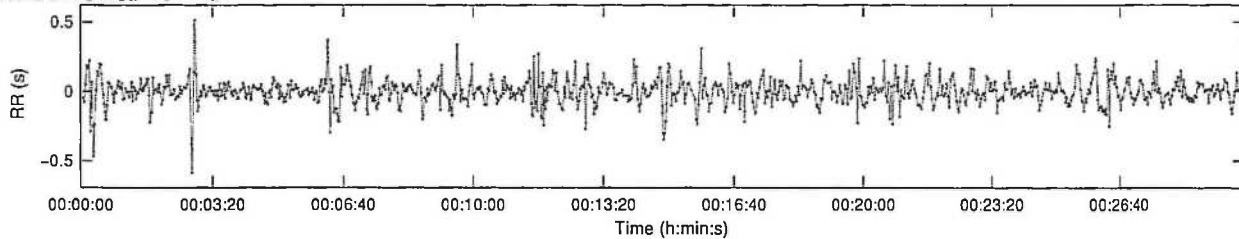
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RR Interval Time Series

Results for a single sample



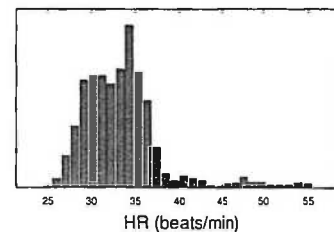
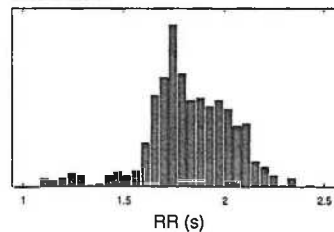
Selected Detrended RR Series



Time-Domain Results

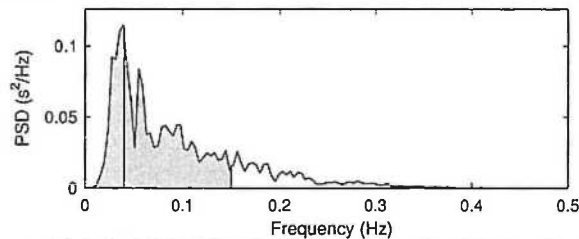
Variable	Units	Value
Mean RR*	(ms)	1822.2
STD RR (SDNN)	(ms)	96.8
Mean HR*	(1/min)	33.45
STD HR	(1/min)	3.80
RMSSD	(ms)	98.3
NN50	(count)	463
pNN50	(%)	45.7
RR triangular index		18.436
TINN	(ms)	760.0

Distributions*



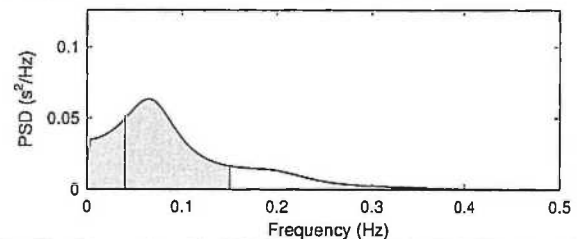
Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	1751	24.2	
LF (0.04-0.15 Hz)	0.0430	4129	57.0	75.2
HF (0.15-0.4 Hz)	0.1563	1360	18.8	24.8
Total		7241		
LF/HF		3.035		

AR Spectrum (AR model order = 16, not factorized)

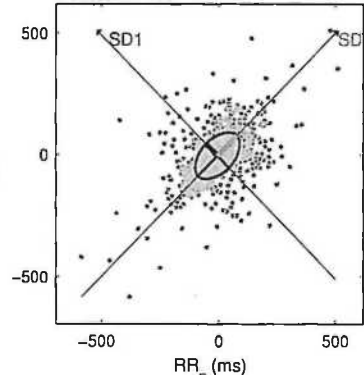


Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	1550	20.8	
LF (0.04-0.15 Hz)	0.0664	4425	59.5	75.2
HF (0.15-0.4 Hz)	0.1523	1462	19.7	24.8
Total		7437		
LF/HF		3.027		

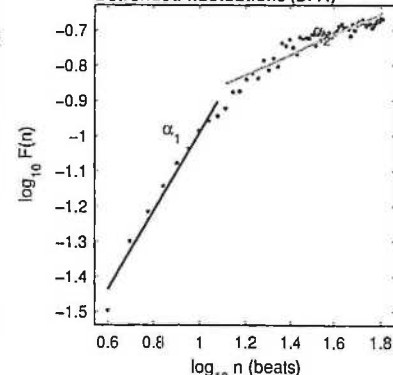
Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	69.5
SD2	(ms)	117.9
Recurrence plot		
Mean line length (Lmean)	(beats)	12.34
Max line length (Lmax)	(beats)	115
Recurrence rate (REC)	(%)	38.53
Determinism (DET)	(%)	98.49
Shannon Entropy (ShanEn)		3.352
Other		
Approximate entropy (ApEn)		1.400
Sample entropy (SampEn)		1.557
Detrended fluctuations (DFA): α1		1.115
Detrended fluctuations (DFA): α2		0.288
Correlation dimension (D2)		4.431
Multiscale entropy (MSE)		0.188 - 1.570

Poincare Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

HRV Analysis Results

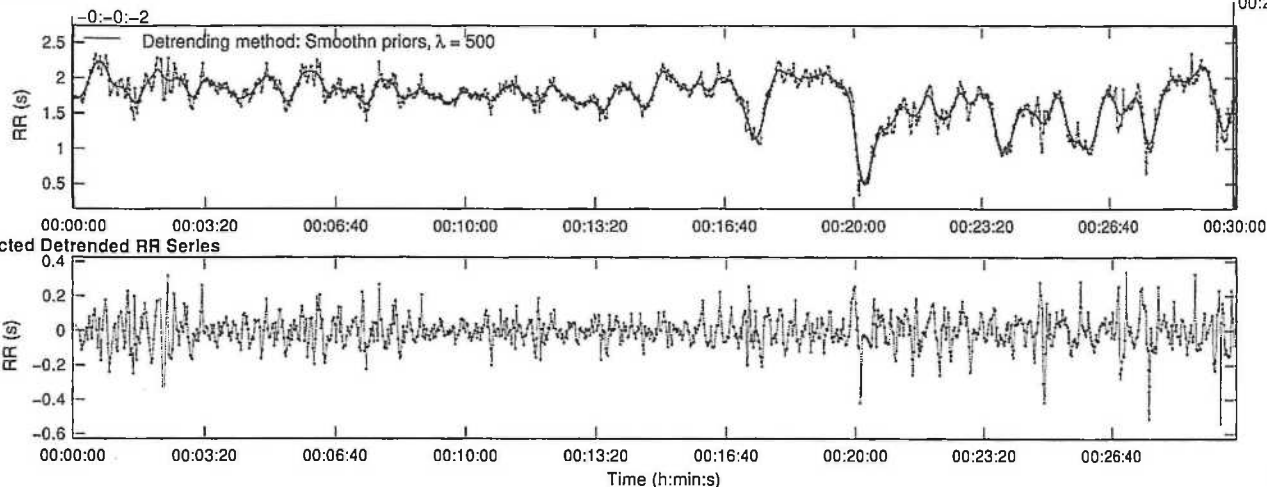
HELGA BASELINE 3.txt - xx/xx/xx - xx:xx:xx

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RR Interval Time Series

Results for a single sample

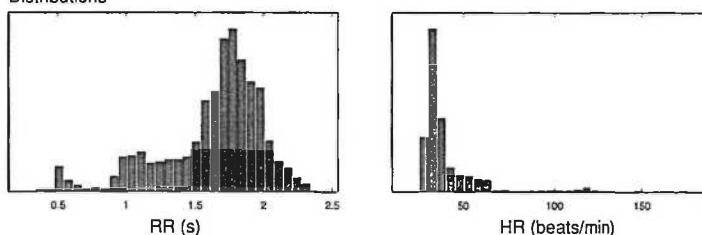
00:29:58



Time-Domain Results

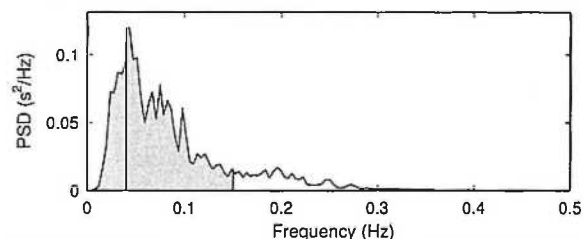
Variable	Units	Value
Mean RR*	(ms)	1628.4
STD RR (SDNN)	(ms)	101.4
Mean HR*	(1/min)	40.28
STD HR	(1/min)	10.48
RMSSD	(ms)	92.7
NN50	(count)	516
pNN50	(%)	46.7
RR triangular index		20.849
TINN	(ms)	630.0

Distributions*



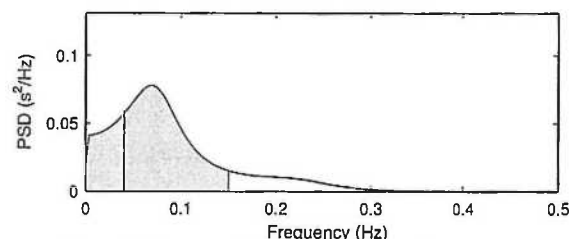
Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	1713	21.5	
LF (0.04-0.15 Hz)	0.0430	5102	63.9	81.4
HF (0.15-0.4 Hz)	0.1953	1169	14.6	18.6
Total		7984		
LF/HF		4.366		

AR Spectrum (AR model order = 16, not factorized)

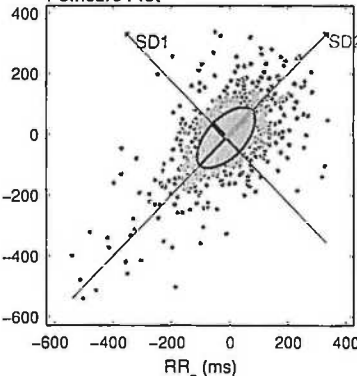


Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	1798	21.4	
LF (0.04-0.15 Hz)	0.0703	5347	63.7	81.0
HF (0.15-0.4 Hz)	0.1523	1253	14.9	19.0
Total		8398		
LF/HF		4.267		

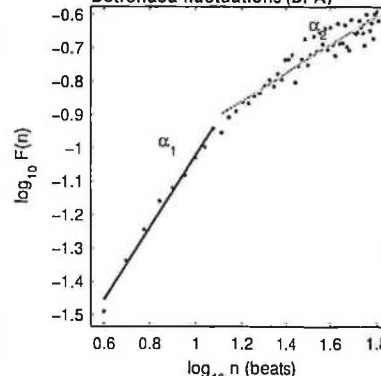
Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	65.6
SD2	(ms)	127.7
Recurrence plot		
Mean line length (Lmean)	(beats)	10.08
Max line length (Lmax)	(beats)	96
Recurrence rate (REC)	(%)	31.98
Determinism (DET)	(%)	97.66
Shannon Entropy (ShanEn)		3.125
Other		
Approximate entropy (ApEn)		1.452
Sample entropy (SampEn)		1.596
Detrended fluctuations (DFA): α_1		1.081
Detrended fluctuations (DFA): α_2		0.427
Correlation dimension (D2)		4.541
Multiscale entropy (MSE)		0.288 - 1.720

Poincare Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

HRV Analysis Results

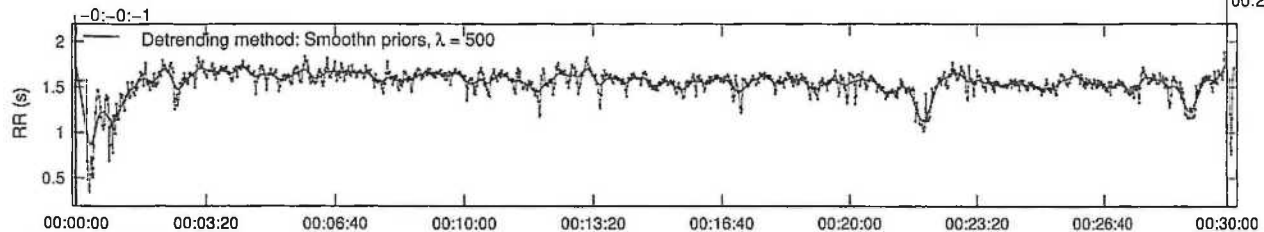
HELGA DAY 1 LOOSE HAY.txt - xx/xx/xx - xx:xx:xx

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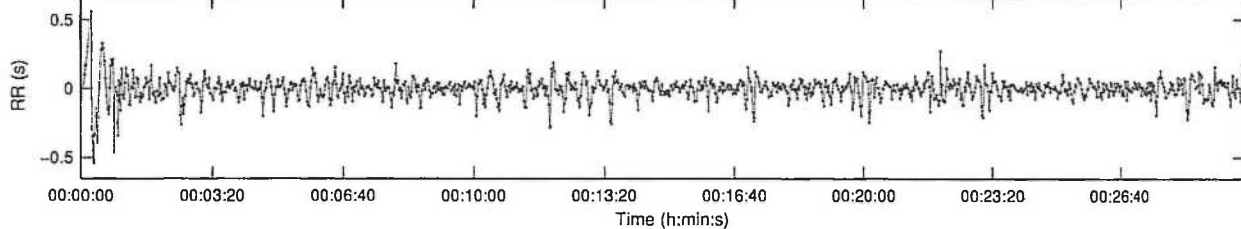
RR Interval Time Series

Results for a single sample

00:29:58



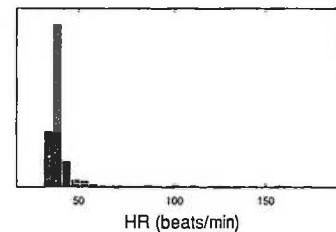
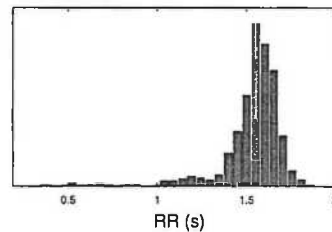
Selected Detrended RR Series



Time-Domain Results

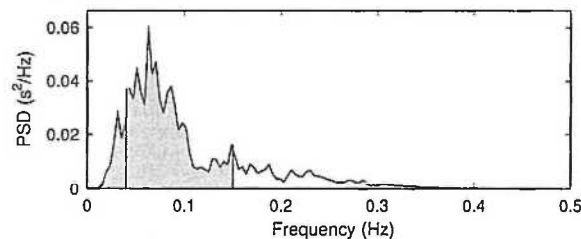
Variable	Units	Value
Mean RR*	(ms)	1530.1
STD RR (SDNN)	(ms)	86.0
Mean HR*	(1/min)	40.34
STD HR	(1/min)	7.13
RMSSD	(ms)	75.6
NN50	(count)	448
pNN50	(%)	37.9
RR triangular index		14.788
TINN	(ms)	755.0

Distributions*



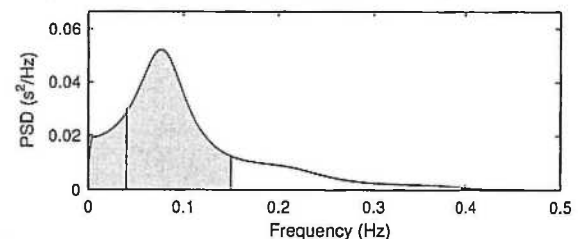
Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0313	382	10.0	
LF (0.04-0.15 Hz)	0.0625	2675	69.9	77.7
HF (0.15-0.4 Hz)	0.1523	769	20.1	22.3
Total		3827		
LF/HF		3.478		

AR Spectrum (AR model order = 16, not factorized)

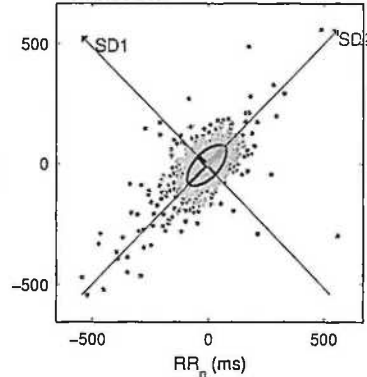


Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	865	15.2	
LF (0.04-0.15 Hz)	0.0781	3629	63.7	75.1
HF (0.15-0.4 Hz)	0.1523	1205	21.1	24.9
Total		5700		
LF/HF		3.013		

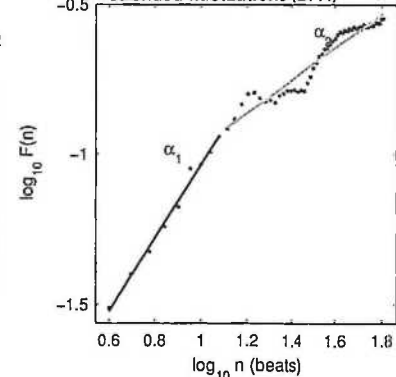
Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	53.4
SD2	(ms)	109.1
Recurrence plot		
Mean line length (Lmean)	(beats)	18.47
Max line length (Lmax)	(beats)	169
Recurrence rate (REC)	(%)	55.05
Determinism (DET)	(%)	99.17
Shannon Entropy (ShanEn)		3.777
Other		
Approximate entropy (ApEn)		1.393
Sample entropy (SampEn)		1.430
Detrended fluctuations (DFA): α1		1.223
Detrended fluctuations (DFA): α2		0.546
Correlation dimension (D2)		4.143
Multiscale entropy (MSE)		0.055 - 1.430

Poincare Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

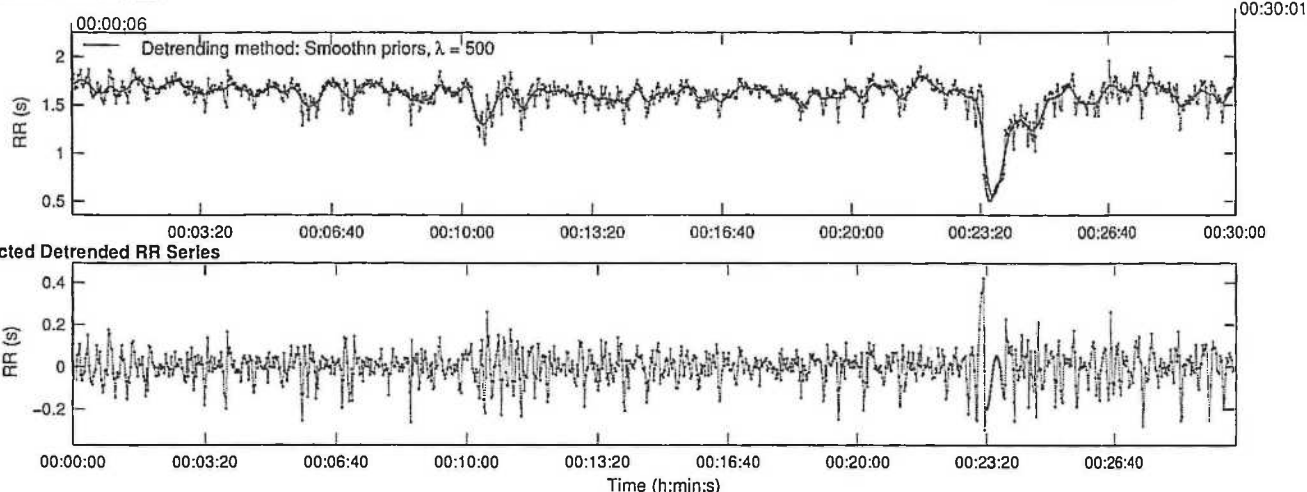
HRV Analysis Results

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RR Interval Time Series

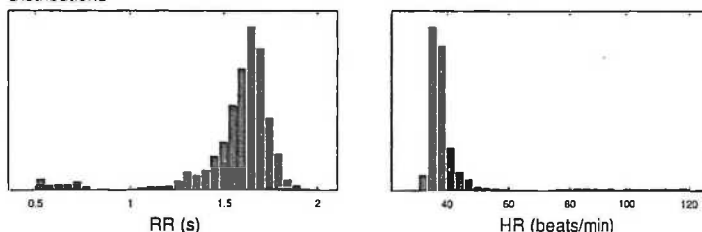
Results for a single sample



Time-Domain Results

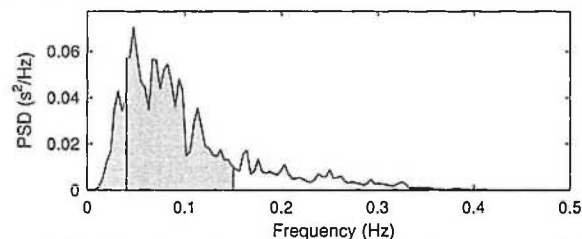
Variable	Units	Value
Mean RR*	(ms)	1561.0
STD RR (SDNN)	(ms)	79.6
Mean HR*	(1/min)	40.33
STD HR	(1/min)	6.80
RMSSD	(ms)	79.5
NN50	(count)	498
pNN50	(%)	43.3
RR triangular index		16.197
TINN	(ms)	515.0

Distributions*



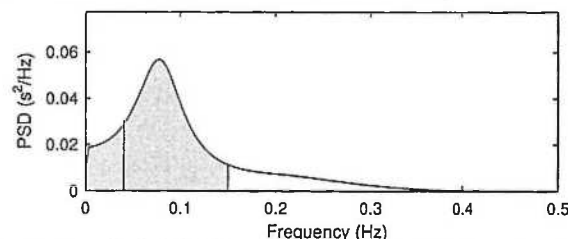
Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0313	693	12.2	
LF (0.04-0.15 Hz)	0.0469	3912	69.1	78.7
HF (0.15-0.4 Hz)	0.1641	1059	18.7	21.3
Total		5664		
LF/HF		3.693		

AR Spectrum (AR model order = 16, not factorized)

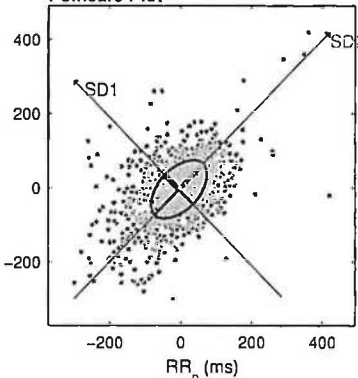


Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	851	15.1	
LF (0.04-0.15 Hz)	0.0781	3774	67.0	78.9
HF (0.15-0.4 Hz)	0.1523	1010	17.9	21.1
Total		5635		
LF/HF		3.735		

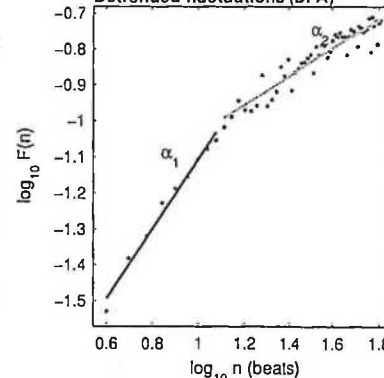
Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	56.2
SD2	(ms)	97.5
Recurrence plot		
Mean line length (Lmean)	(beats)	10.37
Max line length (Lmax)	(beats)	91
Recurrence rate (REC)	(%)	32.73
Determinism (DET)	(%)	97.95
Shannon Entropy (ShanEn)		3.171
Other		
Approximate entropy (ApEn)		1.461
Sample entropy (SampEn)		1.618
Detrended fluctuations (DFA): α1		0.968
Detrended fluctuations (DFA): α2		0.396
Correlation dimension (D2)		4.616
Multiscale entropy (MSE)		0.219 - 1.618

Poincare Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

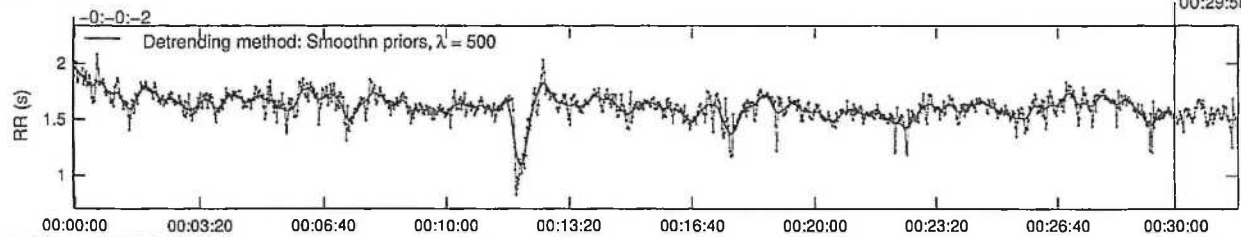
HRV Analysis Results

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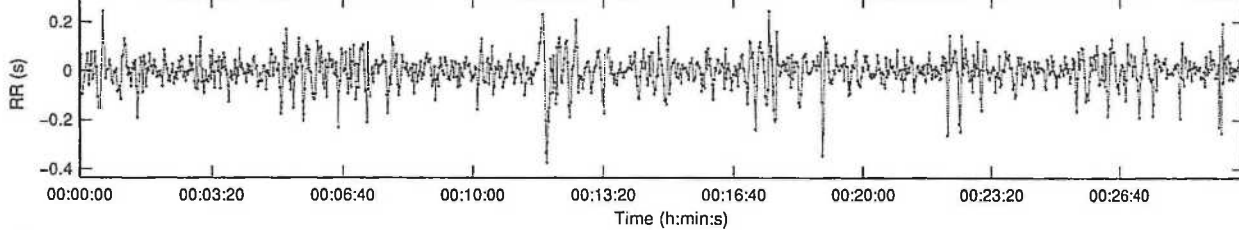
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RR Interval Time Series

Results for a single sample



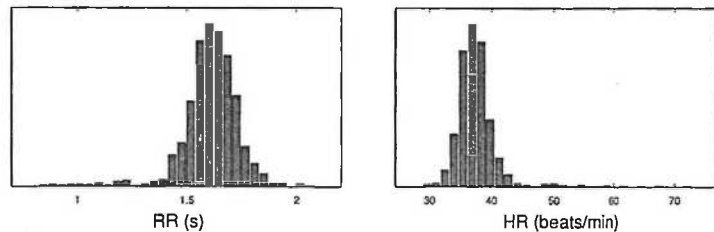
Selected Detrended RR Series



Time-Domain Results

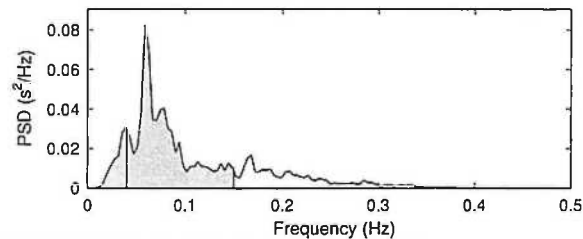
Variable	Units	Value
Mean RR*	(ms)	1607.8
STD RR (SDNN)	(ms)	68.1
Mean HR*	(1/min)	37.62
STD HR	(1/min)	3.18
RMSSD	(ms)	74.6
NN50	(count)	443
pNN50	(%)	39.3
RR triangular index		14.278
TINN	(ms)	440.0

Distributions*



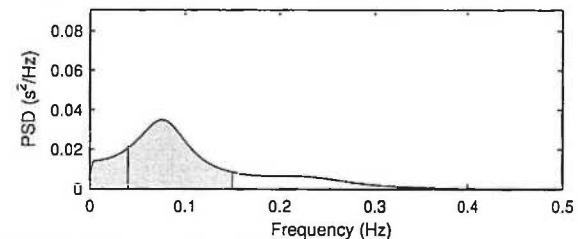
Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	397	10.3	
LF (0.04-0.15 Hz)	0.0586	2557	66.4	74.0
HF (0.15-0.4 Hz)	0.1680	900	23.3	26.0
Total		3854		
LF/HF		2.842		

AR Spectrum (AR model order = 16, not factorized)

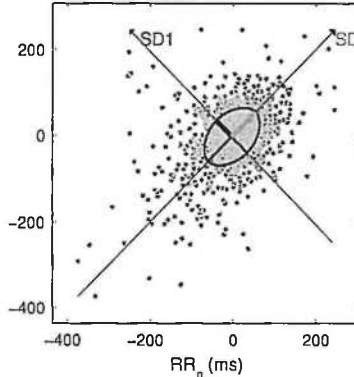


Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	625	15.6	
LF (0.04-0.15 Hz)	0.0742	2467	61.6	73.0
HF (0.15-0.4 Hz)	0.1523	913	22.8	27.0
Total		4005		
LF/HF		2.700		

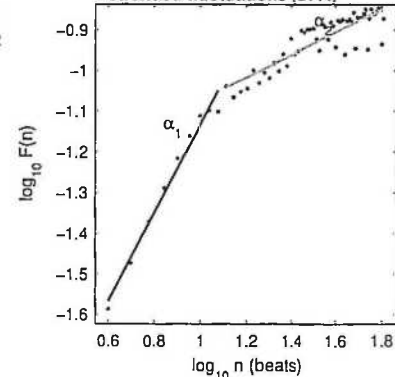
Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	52.8
SD2	(ms)	80.6
Recurrence plot		
Mean line length (Lmean)	(beats)	12.14
Max line length (Lmax)	(beats)	105
Recurrence rate (REC)	(%)	36.50
Determinism (DET)	(%)	98.11
Shannon Entropy (ShanEn)		3.325
Other		
Approximate entropy (ApEn)		1.481
Sample entropy (SampEn)		1.707
Detrended fluctuations (DFA): α_1		1.085
Detrended fluctuations (DFA): α_2		0.278
Correlation dimension (D2)		4.255
Multiscale entropy (MSE)		0.192 - 1.707

Poincare Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

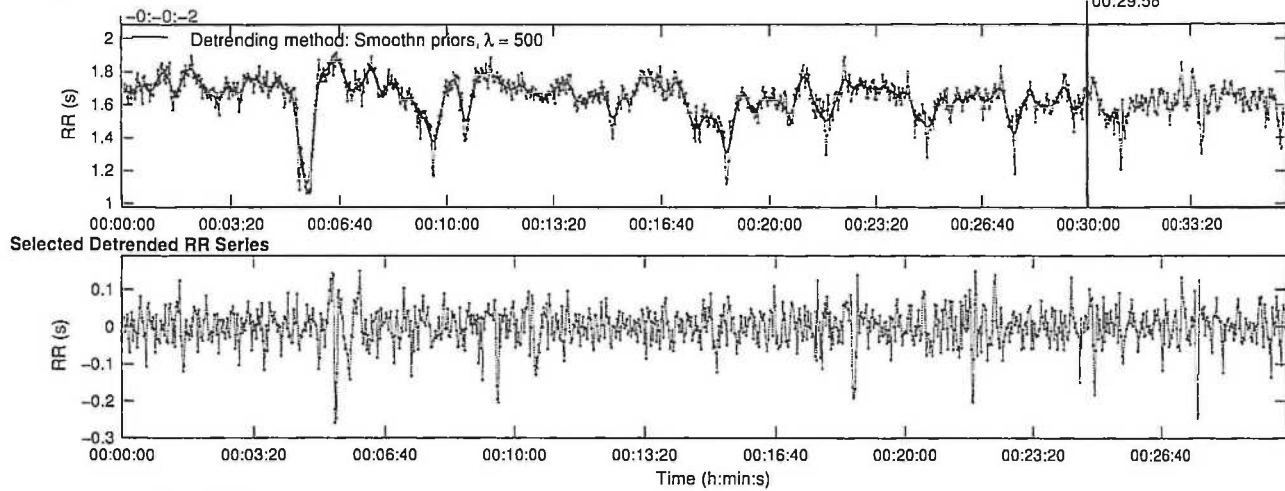
HRV Analysis Results

helga haynet day 1.txt - xx/xx/xx - xx:xx:xx

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RR Interval Time Series

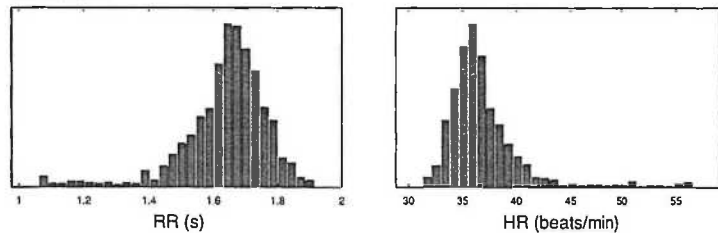
Results for a single sample



Time-Domain Results

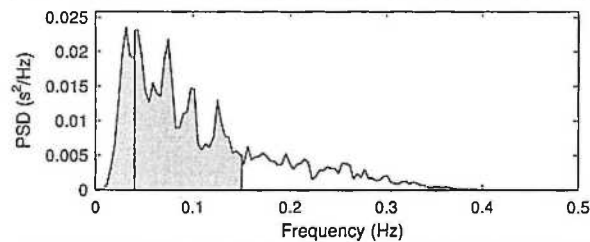
Variable	Units	Value
Mean RR*	(ms)	1636.3
STD RR (SDNN)	(ms)	51.8
Mean HR*	(1/min)	36.96
STD HR	(1/min)	2.91
RMSSD	(ms)	58.5
NN50	(count)	386
pNN50	(%)	35.1
RR triangular index		13.605
TINN	(ms)	305.0

Distributions*



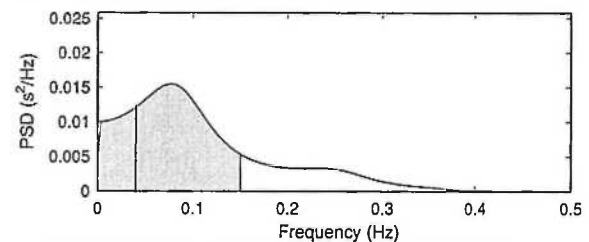
Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



Frequency Band	Peak (Hz)	Power (ms^2)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0313	392	17.5	
LF (0.04-0.15 Hz)	0.0430	1289	57.6	69.9
HF (0.15-0.4 Hz)	0.1563	555	24.8	30.1
Total		2237		
LF/HF		2.323		

AR Spectrum (AR model order = 16, not factorized)

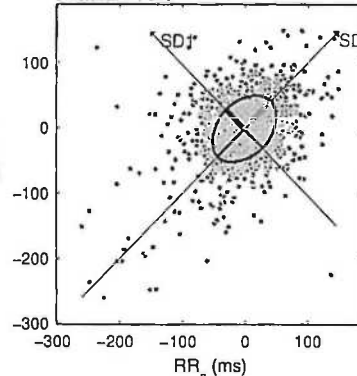


Frequency Band	Peak (Hz)	Power (ms^2)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	417	18.6	
LF (0.04-0.15 Hz)	0.0781	1289	57.4	70.5
HF (0.15-0.4 Hz)	0.1523	539	24.0	29.5
Total		2245		
LF/HF		2.391		

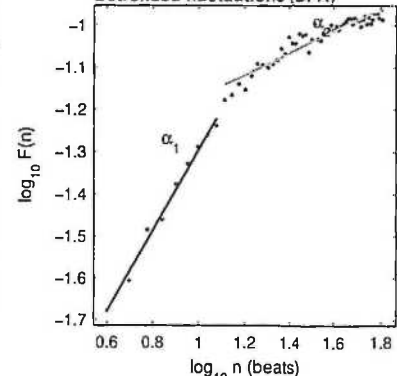
Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	41.4
SD2	(ms)	60.5
Recurrence plot		
Mean line length (Lmean)	(beats)	8.30
Max line length (Lmax)	(beats)	82
Recurrence rate (REC)	(%)	28.76
Determinism (DET)	(%)	96.20
Shannon Entropy (ShanEn)		2.896
Other		
Approximate entropy (ApEn)		1.607
Sample entropy (SampEn)		1.958
Detrended fluctuations (DFA): α_1		0.956
Detrended fluctuations (DFA): α_2		0.262
Correlation dimension (D2)		4.352
Multiscale entropy (MSE)		0.300 - 1.958

Poincare Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

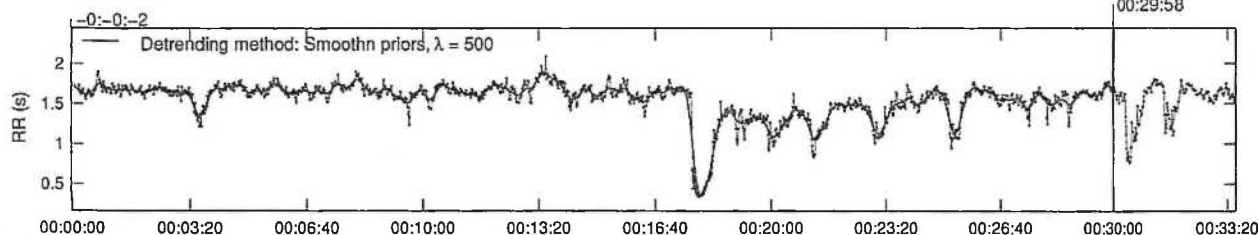
HRV Analysis Results

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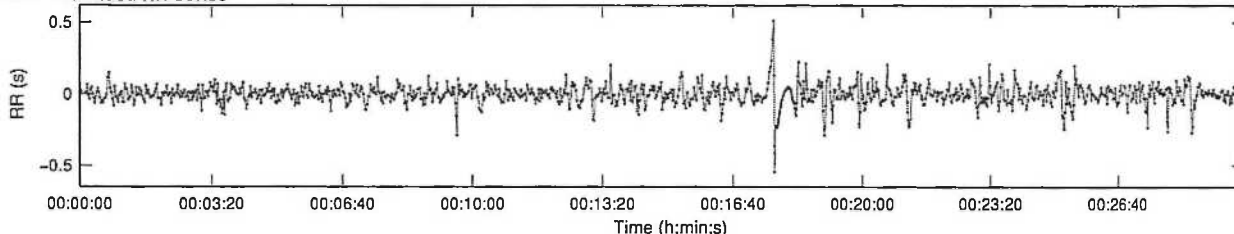
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RR Interval Time Series

Results for a single sample



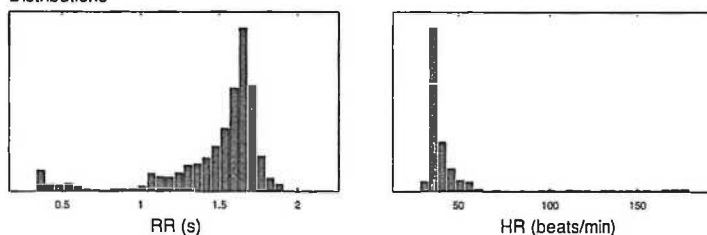
Selected Detrended RR Series



Time-Domain Results

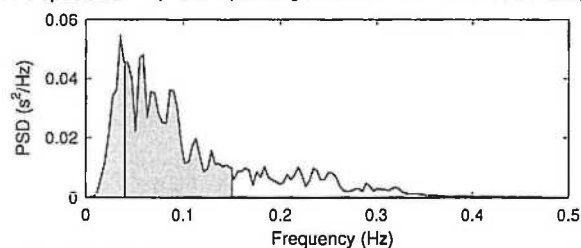
Variable	Units	Value
Mean RR*	(ms)	1476.5
STD RR (SDNN)	(ms)	73.2
Mean HR*	(1/min)	45.93
STD HR	(1/min)	10.10
RMSSD	(ms)	66.7
NN50	(count)	426
pNN50	(%)	35.0
RR triangular index		15.213
TINN	(ms)	720.0

Distributions*



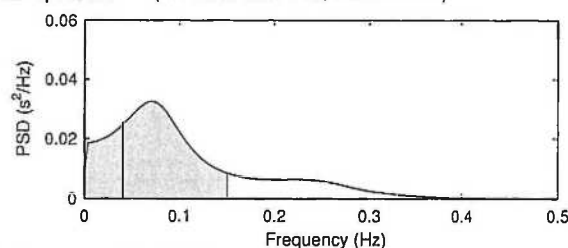
Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0352	784	17.7	
LF (0.04-0.15 Hz)	0.0586	2619	59.1	71.8
HF (0.15-0.4 Hz)	0.1836	1026	23.2	28.2
Total		4429		
LF/HF		2.552		

AR Spectrum (AR model order = 16, not factorized)

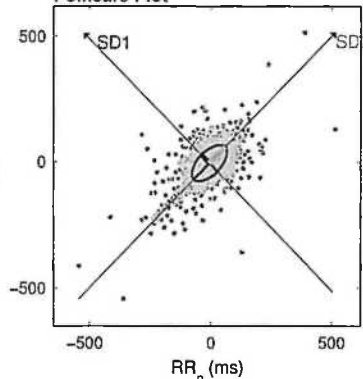


Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	802	19.1	
LF (0.04-0.15 Hz)	0.0703	2420	57.7	71.3
HF (0.15-0.4 Hz)	0.1523	973	23.2	28.7
Total		4195		
LF/HF		2.487		

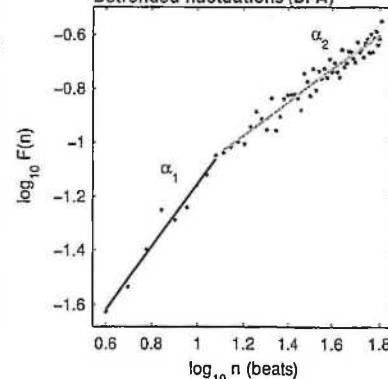
Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	47.1
SD2	(ms)	92.2
Recurrence plot		
Mean line length (Lmean)	(beats)	13.60
Max line length (Lmax)	(beats)	205
Recurrence rate (REC)	(%)	46.49
Determinism (DET)	(%)	98.70
Shannon Entropy (ShanEn)		3.435
Other		
Approximate entropy (ApEn)		1.447
Sample entropy (SampEn)		1.586
Detrended fluctuations (DFA): α_1		1.168
Detrended fluctuations (DFA): α_2		0.615
Correlation dimension (D2)		4.362
Multiscale entropy (MSE)		0.165 - 1.586

Poincare Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

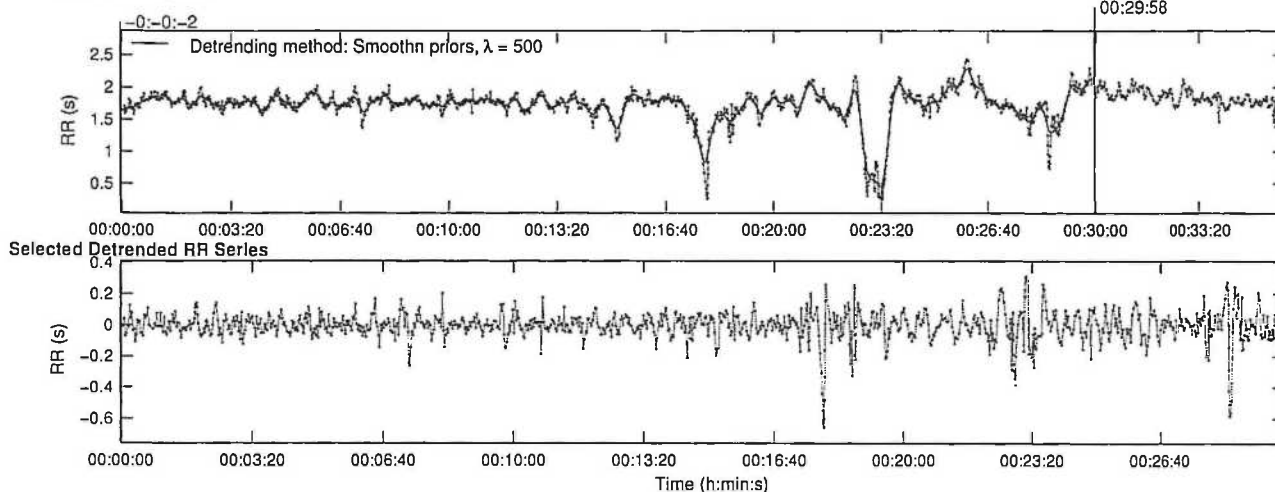
HRV Analysis Results

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RR Interval Time Series

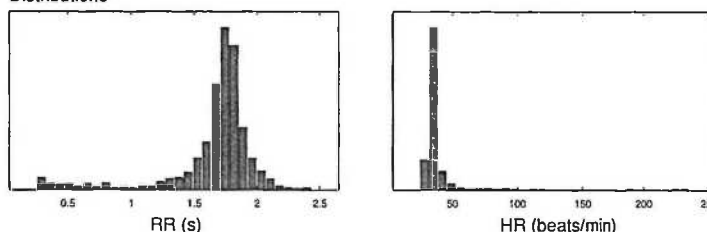
Results for a single sample



Time-Domain Results

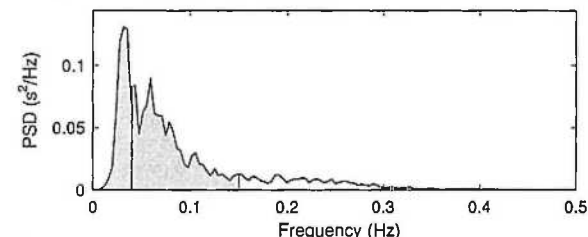
Variable	Units	Value
Mean RR*	(ms)	1647.6
STD RR (SDNN)	(ms)	110.1
Mean HR*	(1/min)	41.99
STD HR	(1/min)	20.05
RMSSD	(ms)	77.4
NN50	(count)	492
pNN50	(%)	44.4
RR triangular index		15.829
TINN	(ms)	685.0

Distributions*



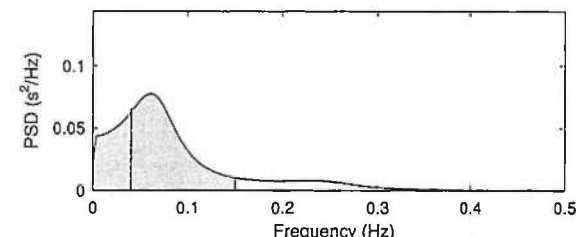
Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



Frequency Band	Peak (Hz)	Power (ms^2)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0313	2047	28.7	
LF (0.04-0.15 Hz)	0.0586	3920	55.0	77.2
HF (0.15-0.4 Hz)	0.1523	1155	16.2	22.8
Total		7122		
LF/HF		3.395		

AR Spectrum (AR model order = 16, not factorized)

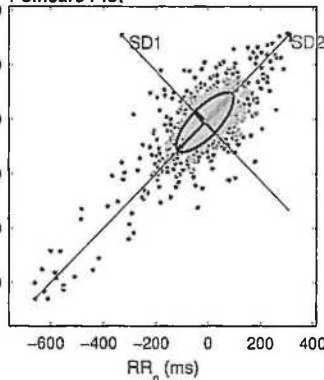


Frequency Band	Peak (Hz)	Power (ms^2)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	1938	25.2	
LF (0.04-0.15 Hz)	0.0625	4636	60.2	80.4
HF (0.15-0.4 Hz)	0.1523	1129	14.7	19.6
Total		7704		
LF/HF		4.104		

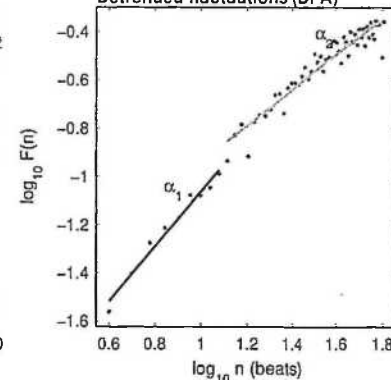
Nonlinear Results

Variable	Units	Value
Polncaire plot		
SD1	(ms)	54.7
SD2	(ms)	145.8
Recurrence plot		
Mean line length (Lmean)	(beats)	20.62
Max line length (Lmax)	(beats)	234
Recurrence rate (REC)	(%)	54.74
Determinism (DET)	(%)	99.14
Shannon Entropy (ShanEn)		3.867
Other		
Approximate entropy (ApEn)		1.404
Sample entropy (SampEn)		1.491
Detrended fluctuations (DFA): α_1		1.141
Detrended fluctuations (DFA): α_2		0.738
Correlation dimension (D2)		4.837
Multiscale entropy (MSE)		0.234 - 1.491

Polncaire Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

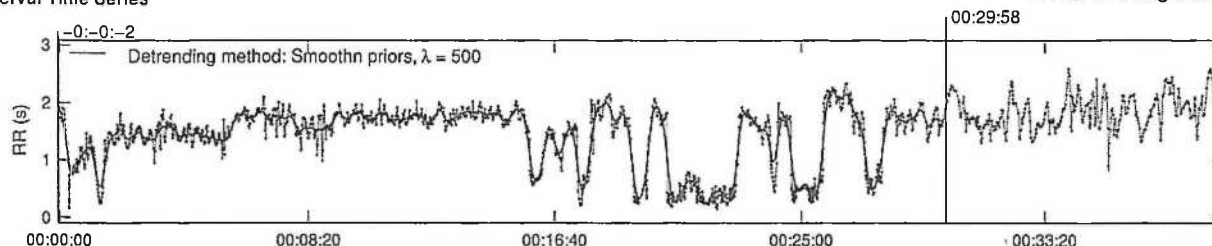
HRV Analysis Results

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greedy

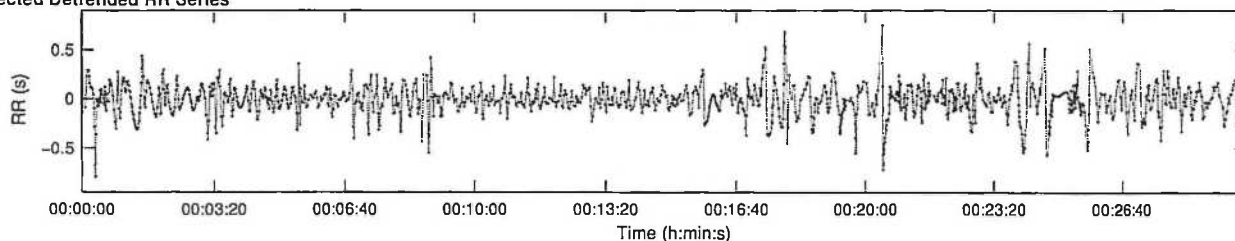
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RR Interval Time Series

Results for a single sample



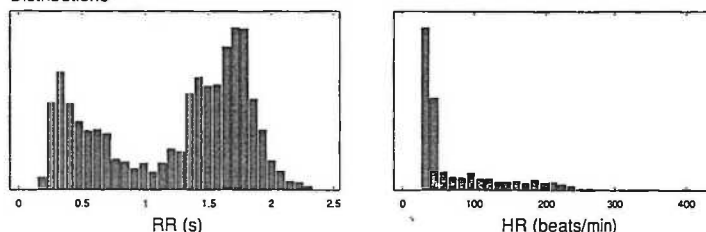
Selected Detrended RR Series



Time-Domain Results

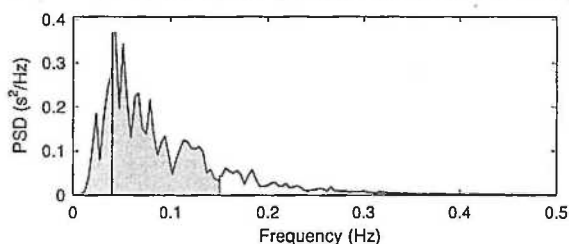
Variable	Units	Value
Mean RR*	(ms)	1231.7
STD RR (SDNN)	(ms)	172.4
Mean HR*	(1/min)	73.33
STD HR	(1/min)	37.98
RMSSD	(ms)	109.6
NN50	(count)	799
pNN50	(%)	54.4
RR triangular index		30.020
TINN	(ms)	1100.0

Distributions*



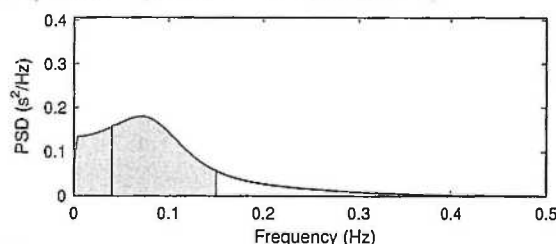
Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	4106	17.6	
LF (0.04-0.15 Hz)	0.0430	15390	65.9	80.0
HF (0.15-0.4 Hz)	0.1563	3836	16.4	19.9
Total		23339		
LF/HF		4.012		

AR Spectrum (AR model order = 16, not factorized)

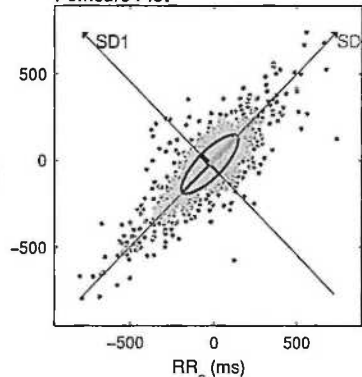


Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	5526	22.7	
LF (0.04-0.15 Hz)	0.0703	14856	61.0	78.8
HF (0.15-0.4 Hz)	0.1523	3985	16.4	21.1
Total		24372		
LF/HF		3.728		

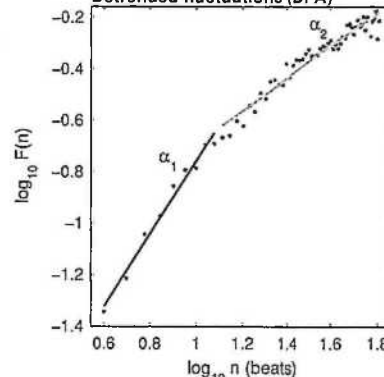
Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	77.6
SD2	(ms)	231.1
Recurrence plot		
Mean line length (Lmean)	(beats)	16.19
Max line length (Lmax)	(beats)	232
Recurrence rate (REC)	(%)	45.57
Determinism (DET)	(%)	99.33
Shannon Entropy (ShanEn)		3.634
Other		
Approximate entropy (ApEn)		1.197
Sample entropy (SampEn)		1.187
Detrended fluctuations (DFA): α1		1.413
Detrended fluctuations (DFA): α2		0.635
Correlation dimension (D2)		3.521
Multiscale entropy (MSE)		0.228 - 1.462

Poincare Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

HRV Analysis Results

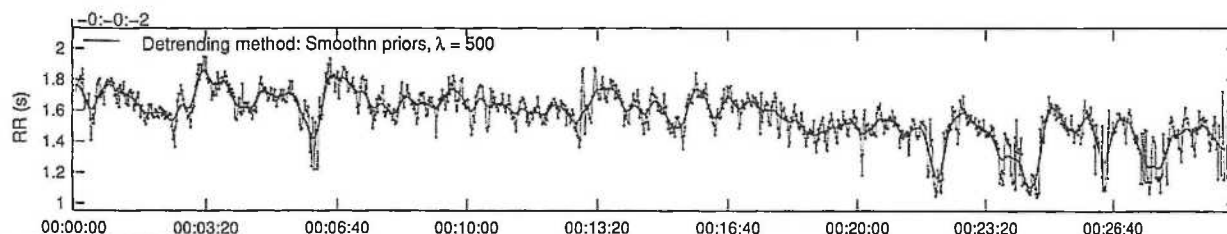
helga sfg day 2.txt - xx/xx/xx - xx:xx:xx

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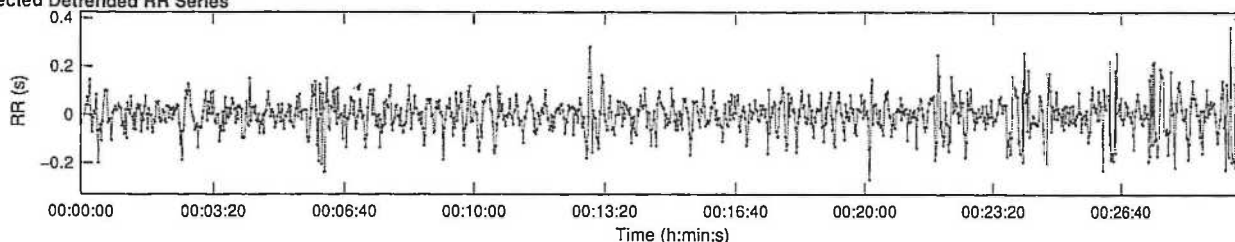
RR Interval Time Series

Results for a single sample

00:29:56



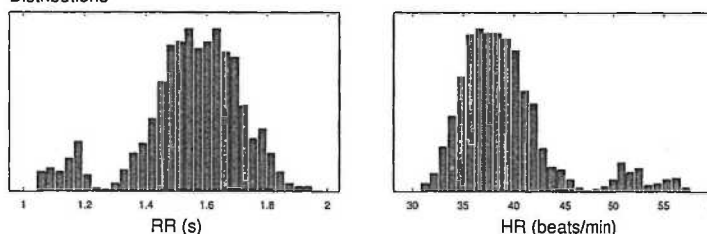
Selected Detrended RR Series



Time-Domain Results

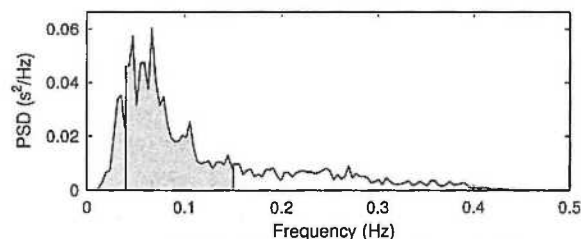
Variable	Units	Value
Mean RR*	(ms)	1547.3
STD RR (SDNN)	(ms)	75.0
Mean HR*	(1/min)	39.32
STD HR	(1/min)	3.47
RMSSD	(ms)	89.5
NN50	(count)	509
pNN50	(%)	43.8
RR triangular index		15.520
TINN	(ms)	455.0

Distributions*



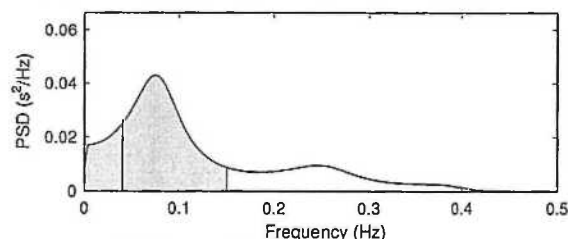
Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0352	479	11.0	
LF (0.04-0.15 Hz)	0.0664	2741	62.7	70.4
HF (0.15-0.4 Hz)	0.1523	1150	26.3	29.5
Total		4371		
LF/HF		2.384		

AR Spectrum (AR model order = 16, not factorized)

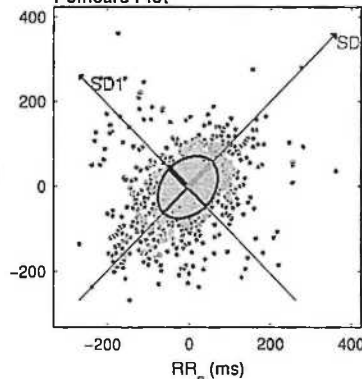


Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	758	15.0	
LF (0.04-0.15 Hz)	0.0742	2902	57.3	67.4
HF (0.15-0.4 Hz)	0.2461	1403	27.7	32.6
Total		5065		
LF/HF		2.068		

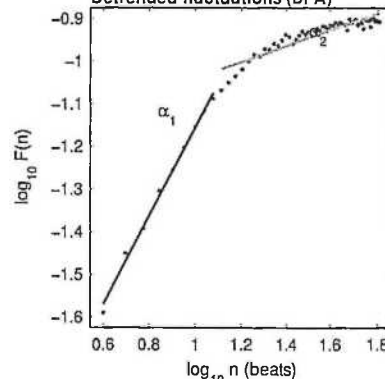
Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	63.3
SD2	(ms)	84.9
Recurrence plot		
Mean line length (Lmean)	(beats)	8.94
Max line length (Lmax)	(beats)	78
Recurrence rate (REC)	(%)	28.98
Determinism (DET)	(%)	96.94
Shannon Entropy (ShanEn)		2.984
Other		
Approximate entropy (ApEn)		1.549
Sample entropy (SampEn)		1.857
Detrended fluctuations (DFA): α1		1.036
Detrended fluctuations (DFA): α2		0.189
Correlation dimension (D2)		5.292
Multiscale entropy (MSE)		0.213 - 1.857

Poincare Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

HRV Analysis Results

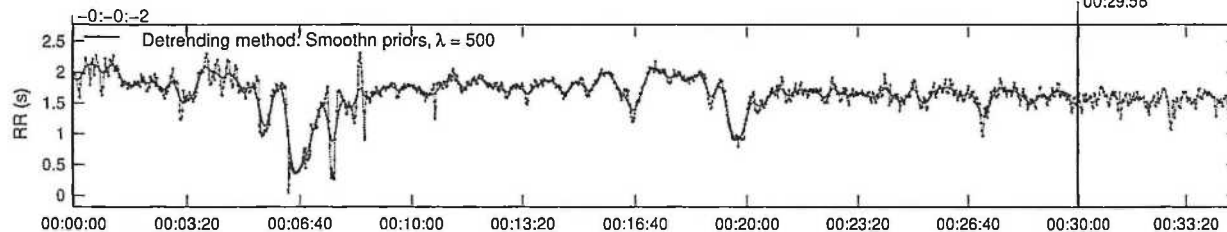
helga sf greedy day 3.txt - xx/xx/xx - xx:xx:xx

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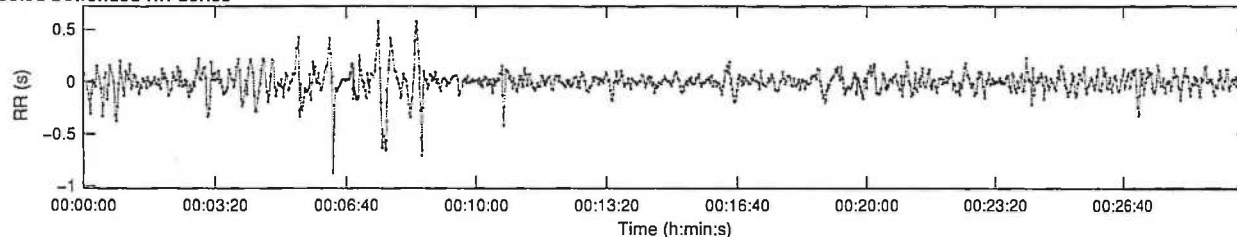
RR Interval Time Series

Results for a single sample

00:29:58



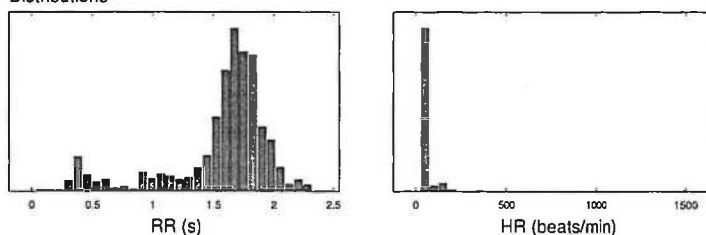
Selected Detrended RR Series



Time-Domain Results

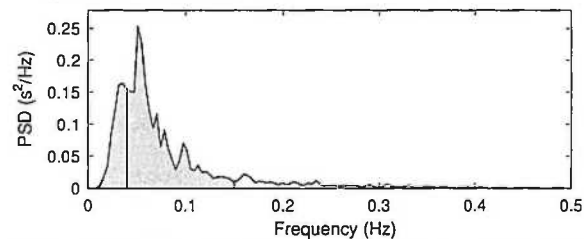
Variable	Units	Value
Mean RR*	(ms)	1562.2
STD RR (SDNN)	(ms)	141.1
Mean HR*	(1/min)	48.08
STD HR	(1/min)	48.49
RMSSD	(ms)	88.2
NN50	(count)	514
pNN50	(%)	43.6
RR triangular index		17.864
TINN	(ms)	1000.0

Distributions*



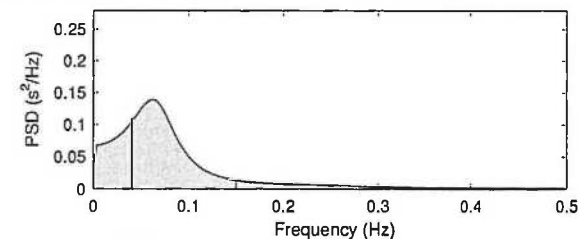
Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0352	2718	22.7	
LF (0.04-0.15 Hz)	0.0508	7946	66.4	85.9
HF (0.15-0.4 Hz)	0.1602	1301	10.9	14.1
Total		11966		
LF/HF		6.110		

AR Spectrum (AR model order = 16, not factorized)

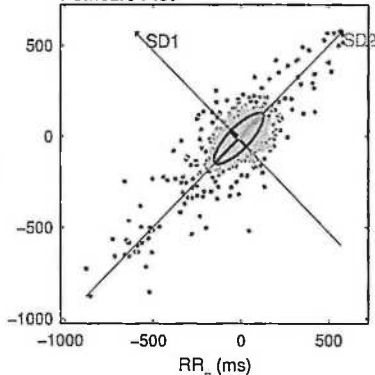


Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	3084	25.6	
LF (0.04-0.15 Hz)	0.0625	7770	64.5	86.7
HF (0.15-0.4 Hz)	0.1523	1188	9.9	13.3
Total		12043		
LF/HF		6.539		

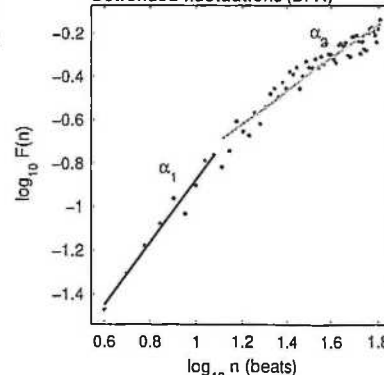
Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	62.4
SD2	(ms)	189.6
Recurrence plot		
Mean line length (Lmean)	(beats)	32.72
Max line length (Lmax)	(beats)	497
Recurrence rate (REC)	(%)	64.38
Determinism (DET)	(%)	99.61
Shannon Entropy (ShanEn)		4.195
Other		
Approximate entropy (ApEn)		1.137
Sample entropy (SampEn)		0.988
Detrended fluctuations (DFA): α1		1.436
Detrended fluctuations (DFA): α2		0.765
Correlation dimension (D2)		3.695
Multiscale entropy (MSE)		0.176 - 0.988

Poincare Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

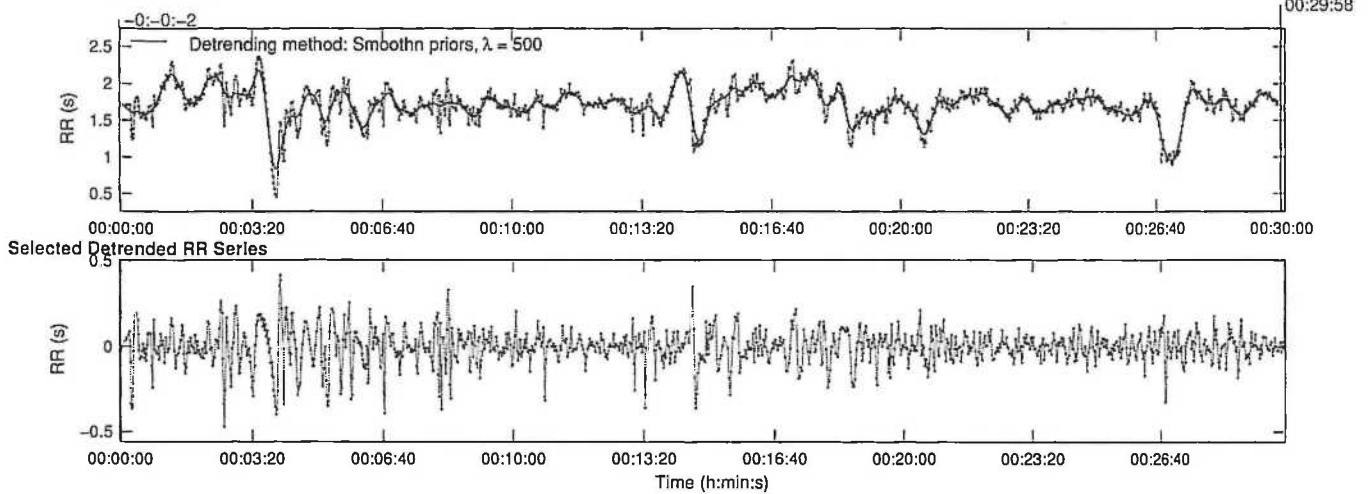
HRV Analysis Results

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RR Interval Time Series

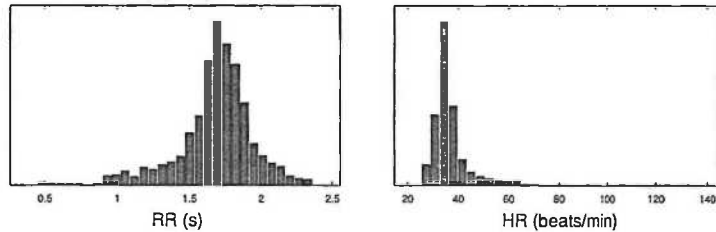
Results for a single sample



Time-Domain Results

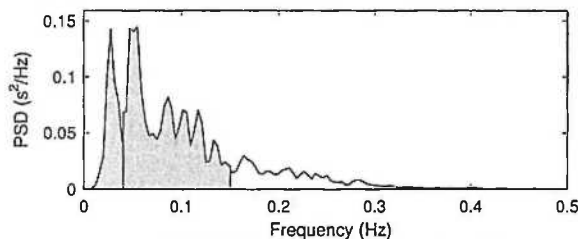
Variable	Units	Value
Mean RR*	(ms)	1680.1
STD RR (SDNN)	(ms)	107.8
Mean HR*	(1/min)	36.94
STD HR	(1/min)	7.32
RMSSD	(ms)	96.2
NN50	(count)	572
pNN50	(%)	50.8
RR triangular index		18.800
TINN	(ms)	630.0

Distributions*



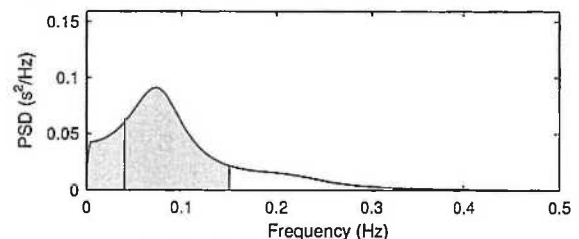
Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



Frequency Band	Peak (Hz)	Power (ms^2)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0273	1935	18.0	
LF (0.04-0.15 Hz)	0.0547	6769	62.8	76.6
HF (0.15-0.4 Hz)	0.1641	2065	19.2	23.4
Total		10772		
LF/HF		3.278		

AR Spectrum (AR model order = 16, not factorized)

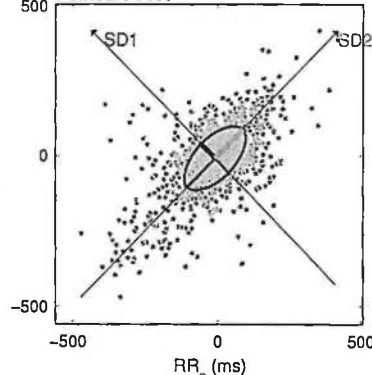


Frequency Band	Peak (Hz)	Power (ms^2)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	1876	18.3	
LF (0.04-0.15 Hz)	0.0742	6485	63.2	77.3
HF (0.15-0.4 Hz)	0.1523	1899	18.5	22.6
Total		10260		
LF/HF		3.416		

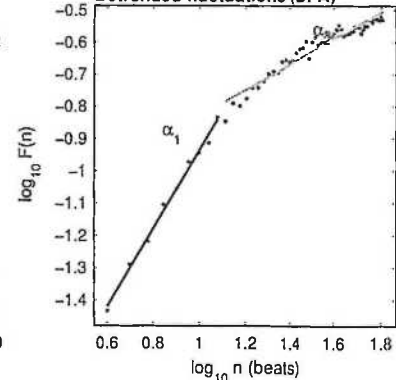
Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	68.0
SD2	(ms)	136.4
Recurrence plot		
Mean line length (Lmean)	(beats)	13.31
Max line length (Lmax)	(beats)	197
Recurrence rate (REC)	(%)	37.82
Determinism (DET)	(%)	98.65
Shannon Entropy (ShanEn)		3.399
Other		
Approximate entropy (ApEn)		1.429
Sample entropy (SampEn)		1.604
Detrended fluctuations (DFA): α_1		1.212
Detrended fluctuations (DFA): α_2		0.403
Correlation dimension (D2)		4.795
Multiscale entropy (MSE)		0.309 - 1.604

Poincare Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

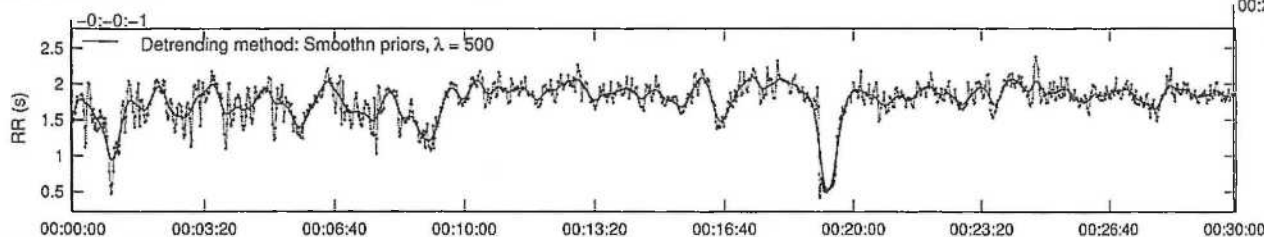
HRV Analysis Results

HELGA SF NORMAL 2.txt - xx/xx/xx - xx:xx:xx

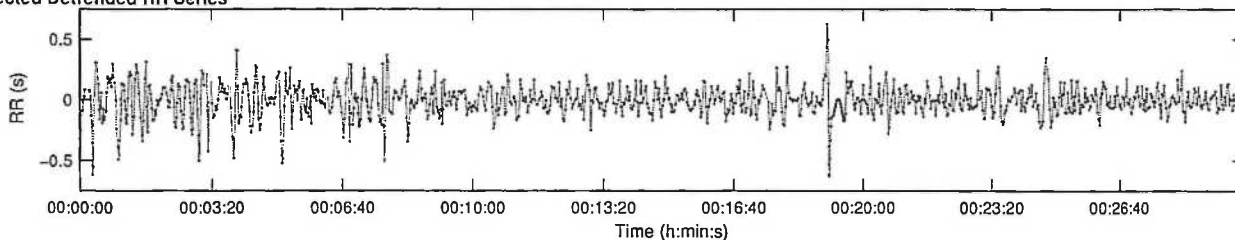
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RR Interval Time Series

Results for a single sample



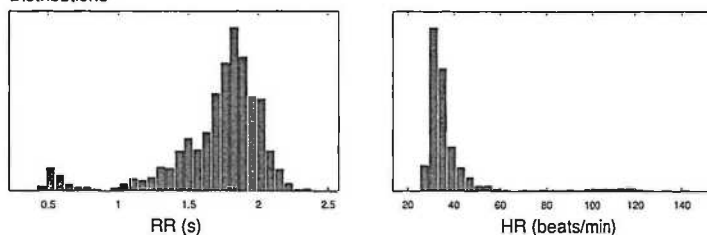
Selected Detrended RR Series



Time-Domain Results

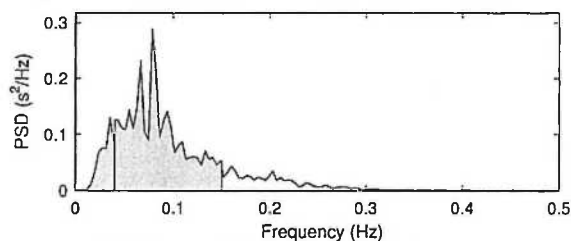
Variable	Units	Value
Mean RR*	(ms)	1702.8
STD RR (SDNN)	(ms)	136.2
Mean HR*	(1/min)	38.34
STD HR	(1/min)	10.41
RMSSD	(ms)	120.3
NN50	(count)	628
pNN50	(%)	57.6
RR triangular index		26.000
TINN	(ms)	890.0

Distributions*



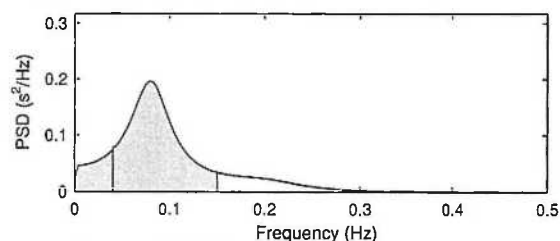
Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0352	1791	11.3	
LF (0.04-0.15 Hz)	0.0781	11567	73.2	82.5
HF (0.15-0.4 Hz)	0.1602	2453	15.5	17.5
Total		15813		
LF/HF		4.715		

AR Spectrum (AR model order = 16, not factorized)

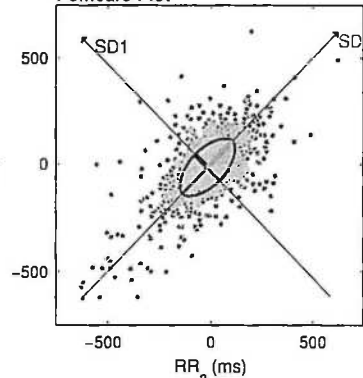


Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	2112	12.8	
LF (0.04-0.15 Hz)	0.0781	11854	71.8	82.4
HF (0.15-0.4 Hz)	0.1523	2533	15.4	17.6
Total		16500		
LF/HF		4.679		

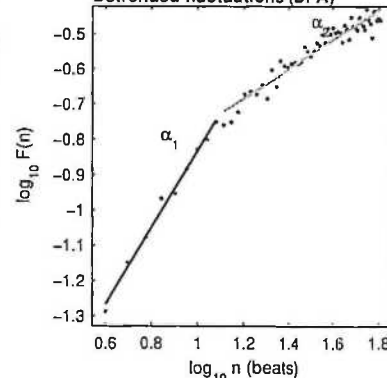
Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	85.1
SD2	(ms)	172.8
Recurrence plot		
Mean line length (Lmean)	(beats)	11.78
Max line length (Lmax)	(beats)	127
Recurrence rate (REC)	(%)	38.41
Determinism (DET)	(%)	98.41
Shannon Entropy (ShanEn)		3.301
Other		
Approximate entropy (ApEn)		1.412
Sample entropy (SampEn)		1.531
Detrended fluctuations (DFA): α1		1.088
Detrended fluctuations (DFA): α2		0.417
Correlation dimension (D2)		2.908
Multiscale entropy (MSE)		0.307 - 1.721

Poincare Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

HRV Analysis Results

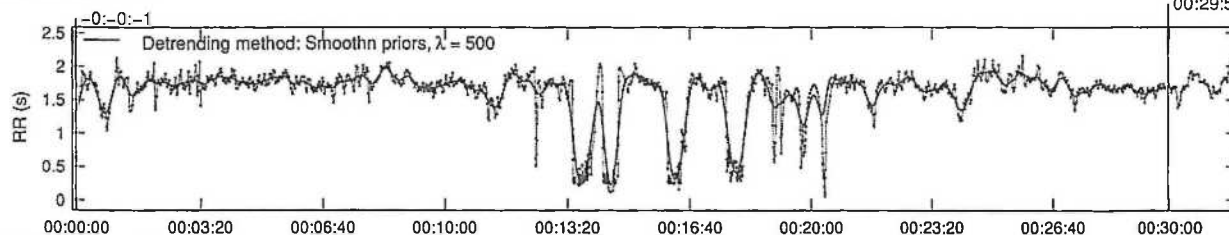
helga SF normal 3.txt - xx/xx/xx - xx:xx:xx

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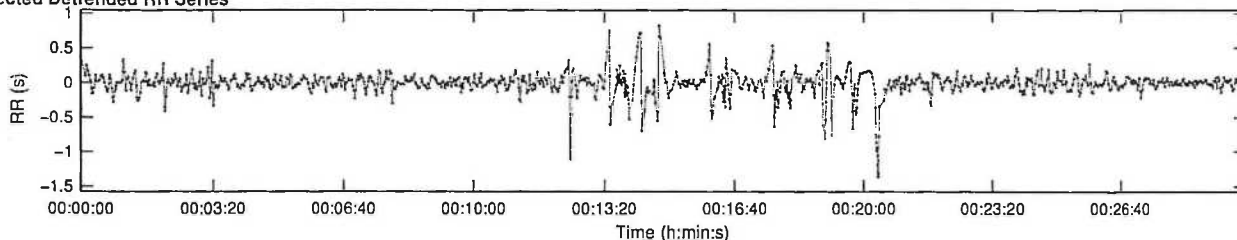
RR Interval Time Series

Results for a single sample

00:29:58



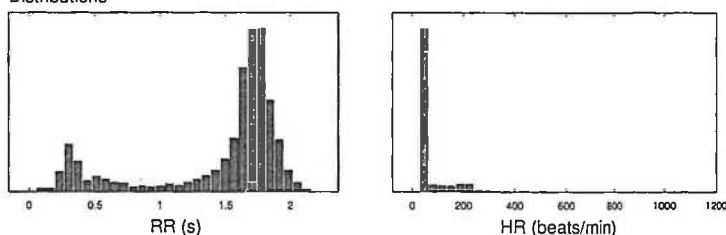
Selected Detrended RR Series



Time-Domain Results

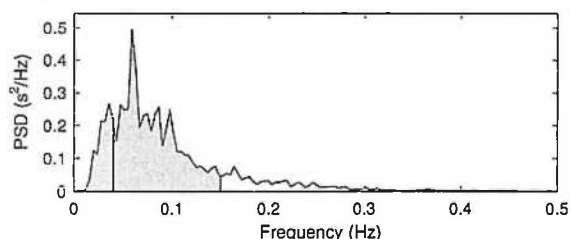
Variable	Units	Value
Mean RR*	(ms)	1463.8
STD RR (SDNN)	(ms)	212.3
Mean HR*	(1/min)	60.38
STD HR	(1/min)	52.13
RMSSD	(ms)	111.8
NN50	(count)	672
pNN50	(%)	53.2
RR triangular index		26.894
TINN	(ms)	1490.0

Distributions*



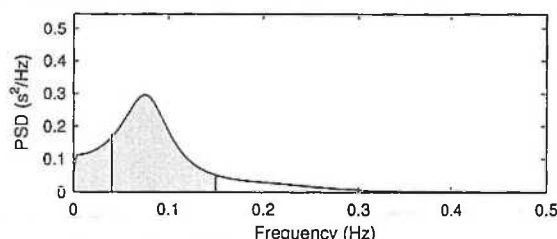
Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0352	4417	15.8	
LF (0.04-0.15 Hz)	0.0586	19380	69.4	82.5
HF (0.15-0.4 Hz)	0.1641	4112	14.7	17.5
Total		27912		
LF/HF		4.713		

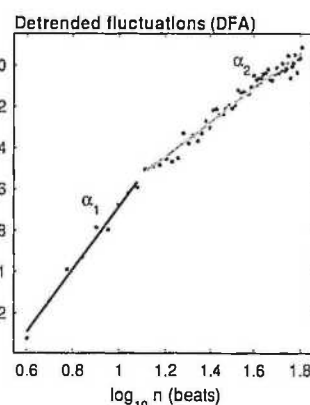
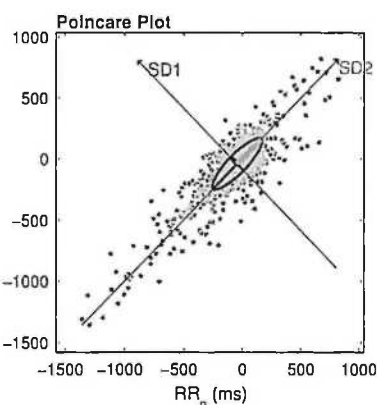
AR Spectrum (AR model order = 16, not factorized)



Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	5009	17.7	
LF (0.04-0.15 Hz)	0.0742	19510	68.8	83.5
HF (0.15-0.4 Hz)	0.1523	3854	13.6	16.5
Total		28377		
LF/HF		5.063		

Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	79.1
SD2	(ms)	289.6
Recurrence plot		
Mean line length (Lmean)	(beats)	28.91
Max line length (Lmax)	(beats)	423.5
Recurrence rate (REC)	(%)	60.46
Determinism (DET)	(%)	99.74
Shannon Entropy (ShanEn)		4.003
Other		
Approximate entropy (ApEn)		1.049
Sample entropy (SampEn)		0.988
Detrended fluctuations (DFA): α1		1.518
Detrended fluctuations (DFA): α2		0.831
Correlation dimension (D2)		3.102
Multiscale entropy (MSE)		0.346 - 1.025



*Results are calculated from the non-detrended selected RR series.

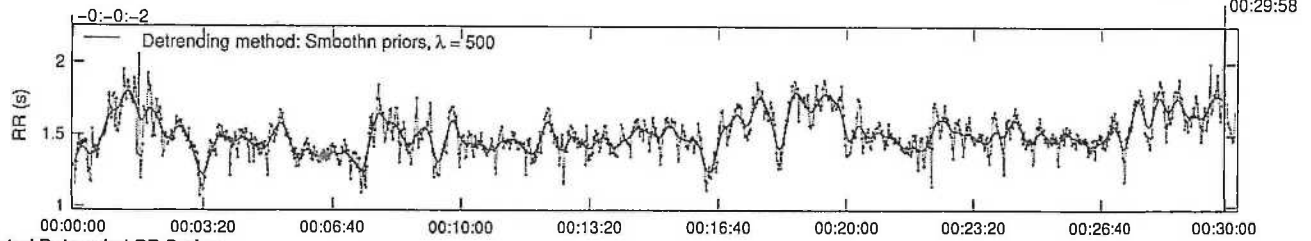
HRV Analysis Results

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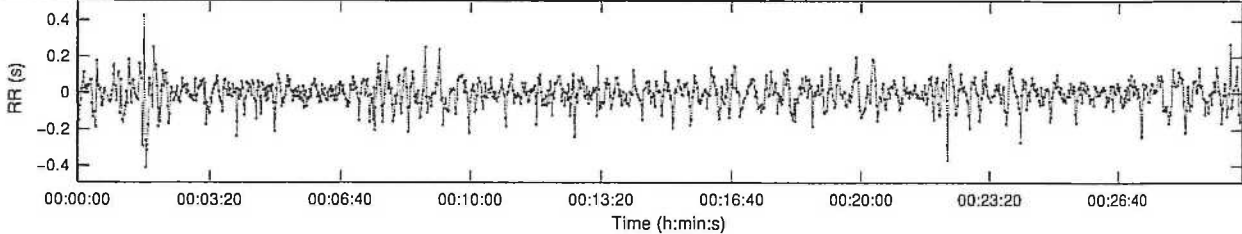
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RR Interval Time Series

Results for a single sample



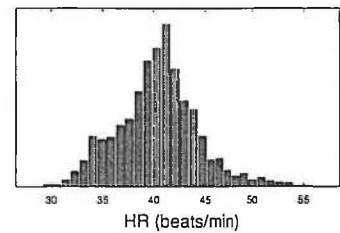
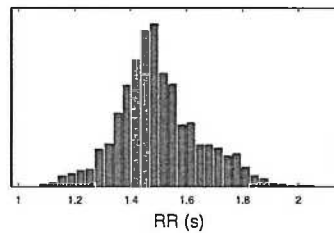
Selected Detrended RR Series



Time-Domain Results

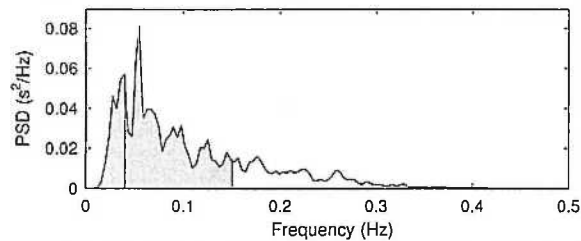
Variable	Units	Value
Mean RR*	(ms)	1498.0
STD RR (SDNN)	(ms)	76.3
Mean HR*	(1/min)	40.44
STD HR	(1/min)	3.17
RMSSD	(ms)	76.8
NN50	(count)	500
pNN50	(%)	41.2
RR triangular index		17.127
TINN	(ms)	585.0

Distributions*



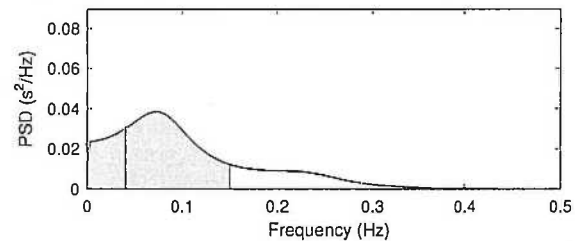
Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	867	17.1	
LF (0.04-0.15 Hz)	0.0547	2985	58.8	70.9
HF (0.15-0.4 Hz)	0.1758	1225	24.1	29.1
Total		5077		
LF/HF		2.436		

AR Spectrum (AR model order = 16, not factorized)

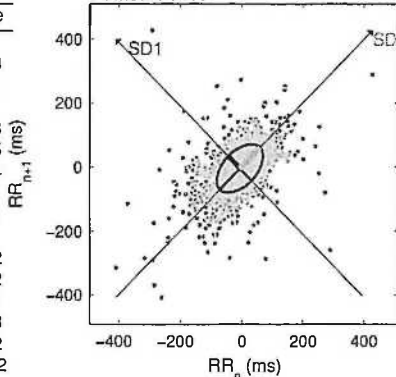


Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	1004	19.0	
LF (0.04-0.15 Hz)	0.0742	3054	57.9	71.5
HF (0.15-0.4 Hz)	0.1523	1219	23.1	28.5
Total		5278		
LF/HF		2.505		

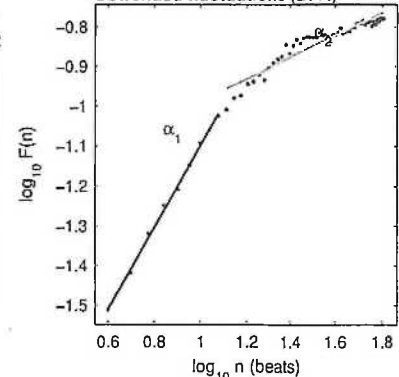
Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	54.3
SD2	(ms)	93.1
Recurrence plot		
Mean line length (Lmean)	(beats)	9.48
Max line length (Lmax)	(beats)	135
Recurrence rate (REC)	(%)	31.14
Determinism (DET)	(%)	97.61
Shannon Entropy (ShanEn)		3.051
Other		
Approximate entropy (ApEn)		1.512
Sample entropy (SampEn)		1.762
Detrended fluctuations (DFA): α1		1.031
Detrended fluctuations (DFA): α2		0.278
Correlation dimension (D2)		4.442
Multiscale entropy (MSE)		0.386 - 1.762

Poincare Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

HRV Analysis Results

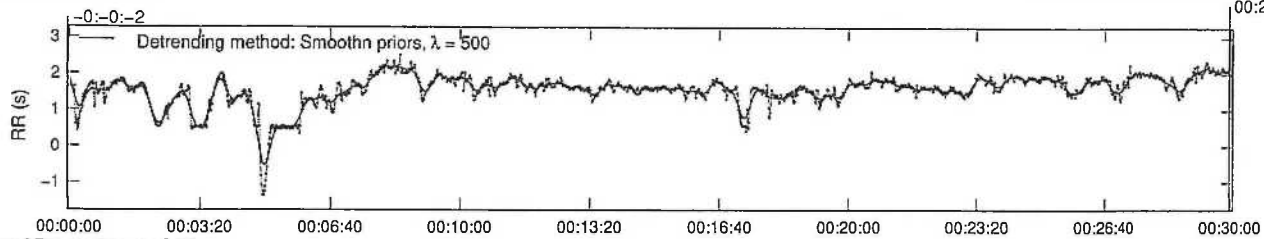
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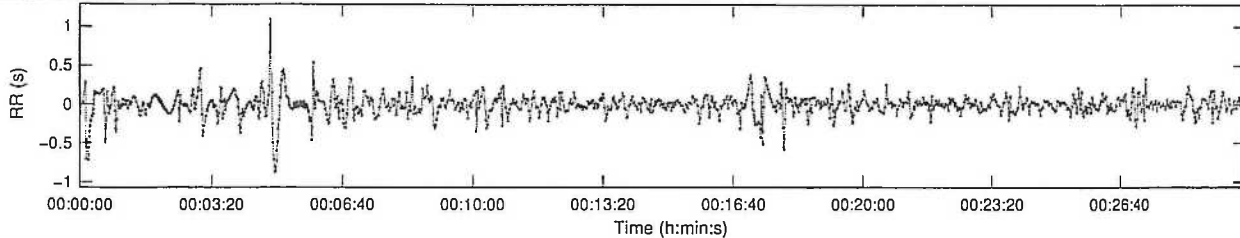
RR Interval Time Series

Results for a single sample

00:29:58



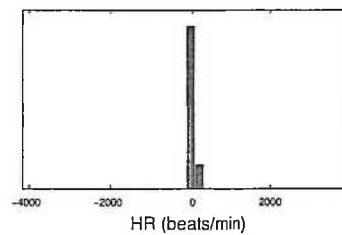
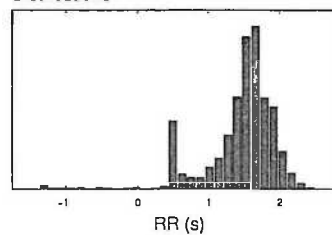
Selected Detrended RR Series



Time-Domain Results

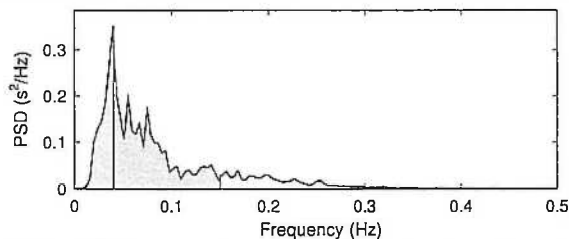
Variable	Units	Value
Mean RR*	(ms)	1453.3
STD RR (SDNN)	(ms)	156.4
Mean HR*	(1/min)	45.32
STD HR	(1/min)	134.25
RMSSD	(ms)	107.9
NN50	(count)	627
pNN50	(%)	49.4
RR triangular index		23.981
TINN	(ms)	1340.0

Distributions*

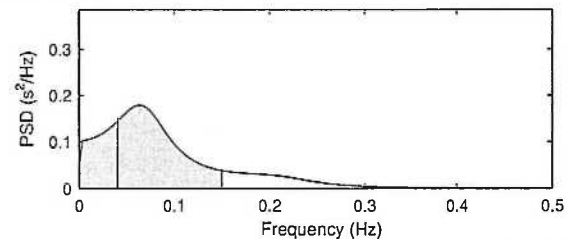


Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



AR Spectrum (AR model order = 16, not factorized)



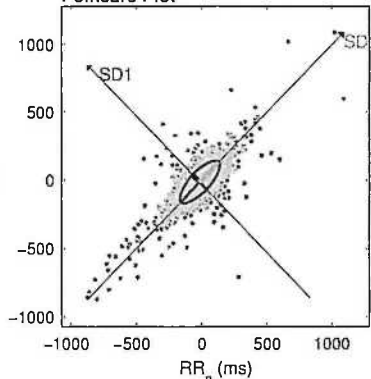
Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	4304	26.1	
LF (0.04-0.15 Hz)	0.0547	9434	57.3	77.5
HF (0.15-0.4 Hz)	0.1680	2732	16.6	22.5
Total		16472		
LF/HF		3.453		

Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	4560	22.8	
LF (0.04-0.15 Hz)	0.0625	12079	60.4	78.3
HF (0.15-0.4 Hz)	0.1523	3342	16.7	21.7
Total		19983		
LF/HF		3.614		

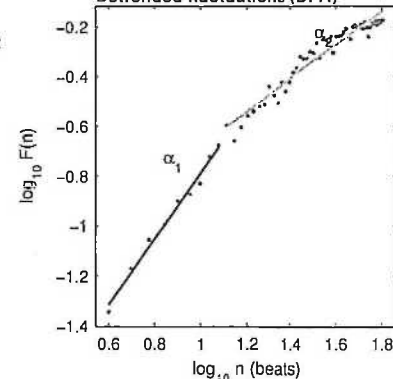
Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	76.3
SD2	(ms)	207.5
Recurrence plot		
Mean line length (Lmean)	(beats)	19.33
Max line length (Lmax)	(beats)	248
Recurrence rate (REC)	(%)	54.07
Determinism (DET)	(%)	99.58
Shannon Entropy (ShanEn)		3.824
Other		
Approximate entropy (ApEn)		1.151
Sample entropy (SampEn)		1.097
Detrended fluctuations (DFA): α1		1.315
Detrended fluctuations (DFA): α2		0.677
Correlation dimension (D2)		4.139
Multiscale entropy (MSE)		0.269 - 1.232

Poincare Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

HRV Analysis Results

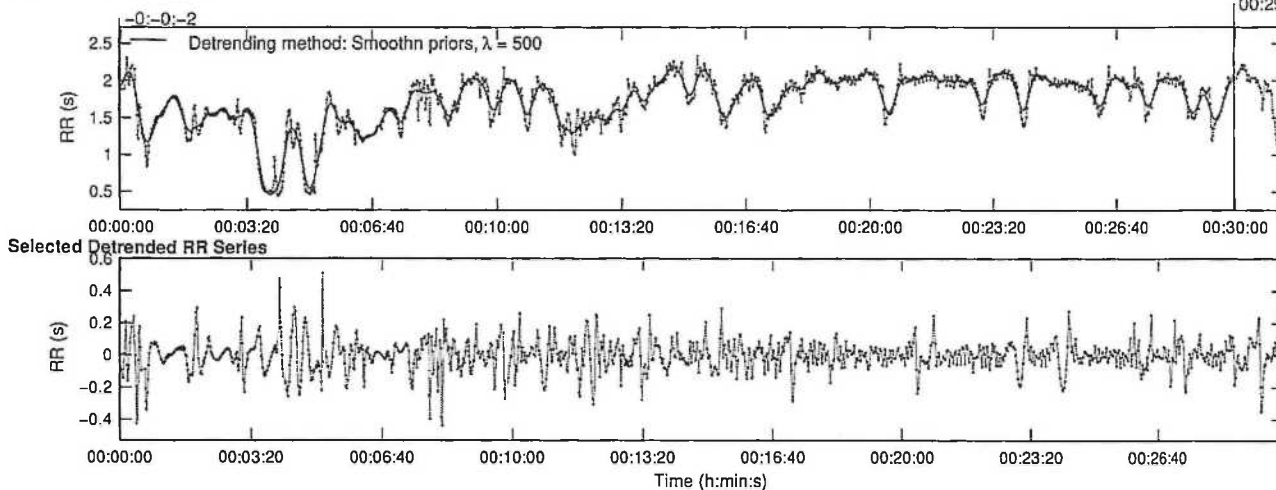
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RR Interval Time Series

Results for a single sample

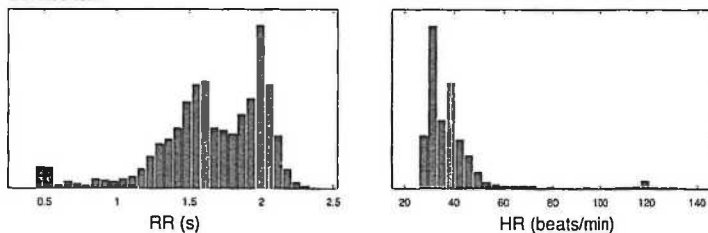
00:29:58



Time-Domain Results

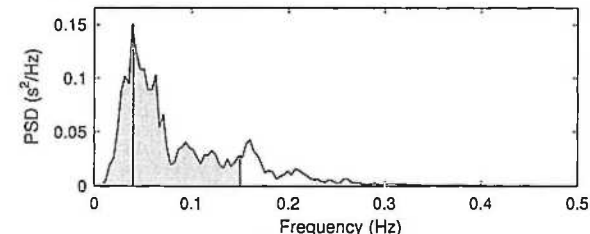
Variable	Units	Value
Mean RR*	(ms)	1651.5
STD RR (SDNN)	(ms)	104.7
Mean HR*	(1/min)	39.90
STD HR	(1/min)	11.09
RMSSD	(ms)	85.8
NN50	(count)	503
pNN50	(%)	44.5
RR triangular index		18.867
TINN	(ms)	675.0

Distributions*



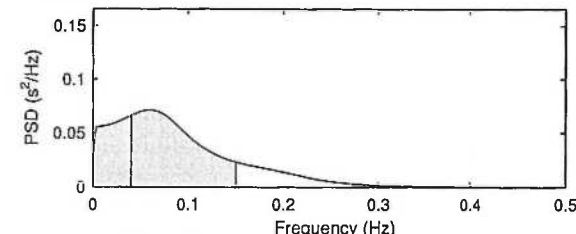
Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



Frequency Band	Peak (Hz)	Power (ms^2)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	1942	22.0	
LF (0.04-0.15 Hz)	0.0430	5188	58.8	75.4
HF (0.15-0.4 Hz)	0.1602	1695	19.2	24.6
Total		8827		
LF/HF		3.060		

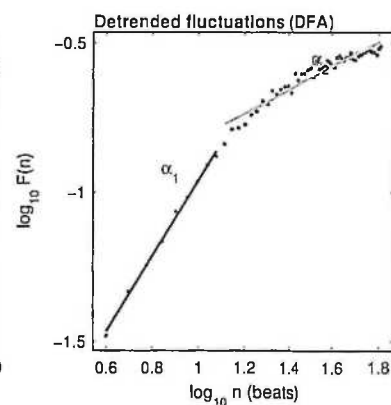
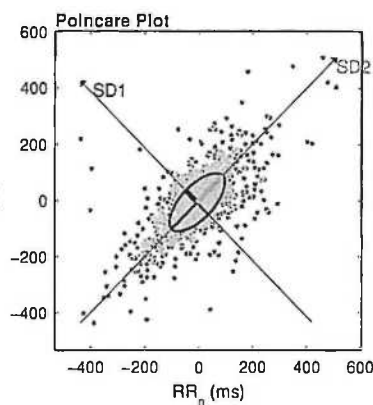
AR Spectrum (AR model order = 16, not factorized)



Frequency Band	Peak (Hz)	Power (ms^2)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	2314	24.5	
LF (0.04-0.15 Hz)	0.0586	5521	58.5	77.5
HF (0.15-0.4 Hz)	0.1523	1601	17.0	22.5
Total		9437		
LF/HF		3.449		

Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	60.7
SD2	(ms)	135.1
Recurrence plot		
Mean line length (Lmean)	(beats)	14.09
Max line length (Lmax)	(beats)	124
Recurrence rate (REC)	(%)	38.98
Determinism (DET)	(%)	98.97
Shannon Entropy (ShanEn)		3.512
Other		
Approximate entropy (ApEn)		1.306
Sample entropy (SampEn)		1.265
Detrended fluctuations (DFA): α_1		1.267
Detrended fluctuations (DFA): α_2		0.400
Correlation dimension (D2)		3.628
Multiscale entropy (MSE)		0.416 - 1.265



*Results are calculated from the non-detrended selected RR series.

HRV Analysis Results

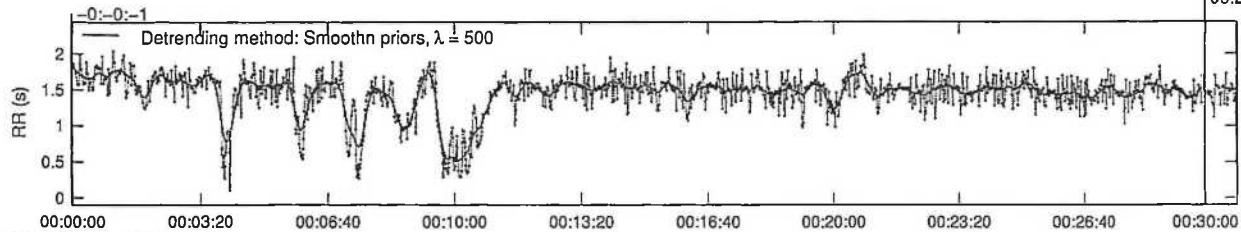
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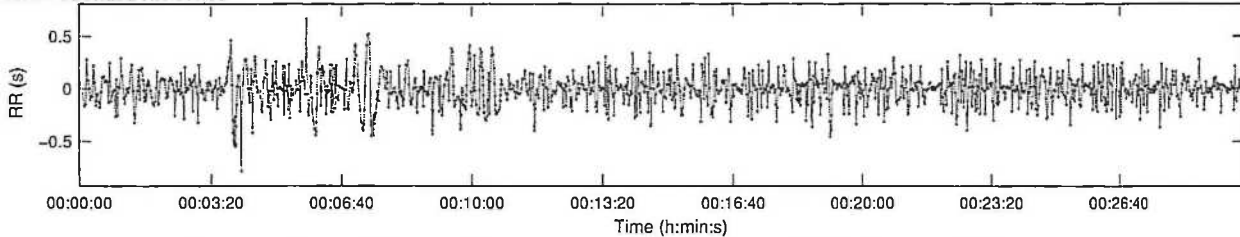
RR Interval Time Series

Results for a single sample

00:29:58



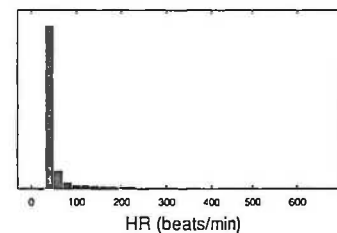
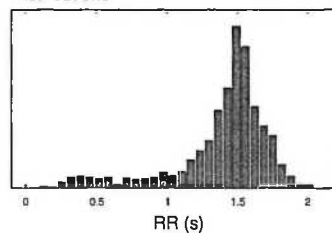
Selected Detrended RR Series



Time-Domain Results

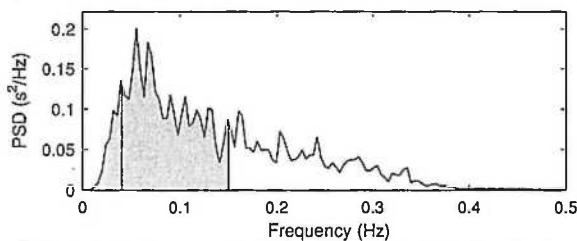
Variable	Units	Value
Mean RR*	(ms)	1391.5
STD RR (SDNN)	(ms)	166.5
Mean HR*	(1/min)	49.98
STD HR	(1/min)	28.33
RMSSD	(ms)	171.0
NN50	(count)	897
pNN50	(%)	65.9
RR triangular index		25.222
TINN	(ms)	1030.0

Distributions*



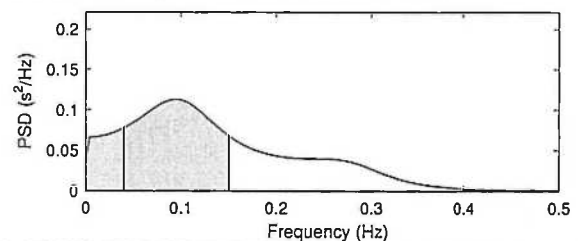
Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	1737	8.2	
LF (0.04-0.15 Hz)	0.0547	11595	54.5	59.3
HF (0.15-0.4 Hz)	0.1602	7956	37.4	40.7
Total		21292		
LF/HF		1.457		

AR Spectrum (AR model order = 16, not factorized)

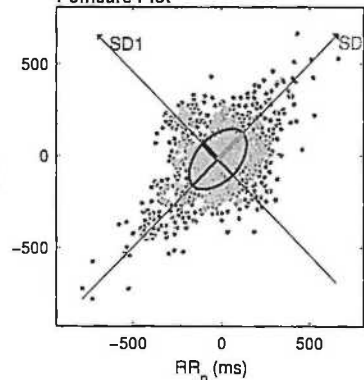


Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	2707	13.1	
LF (0.04-0.15 Hz)	0.0938	10512	50.8	58.5
HF (0.15-0.4 Hz)	0.1523	7464	36.1	41.5
Total		20688		
LF/HF		1.408		

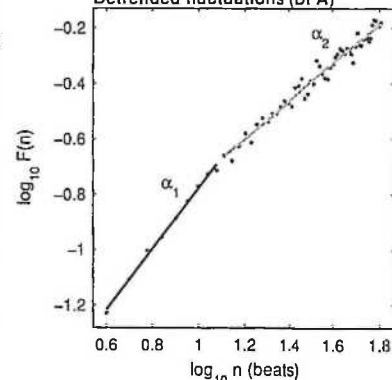
Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	120.9
SD2	(ms)	202.1
Recurrence plot		
Mean line length (Lmean)	(beats)	9.73
Max line length (Lmax)	(beats)	98
Recurrence rate (REC)	(%)	31.96
Determinism (DET)	(%)	97.48
Shannon Entropy (ShanEn)		3.090
Other		
Approximate entropy (ApEn)		1.399
Sample entropy (SampEn)		1.383
Detrended fluctuations (DFA): α1		1.097
Detrended fluctuations (DFA): α2		0.689
Correlation dimension (D2)		0.157
Multiscale entropy (MSE)		0.424 - 1.509

Poincare Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

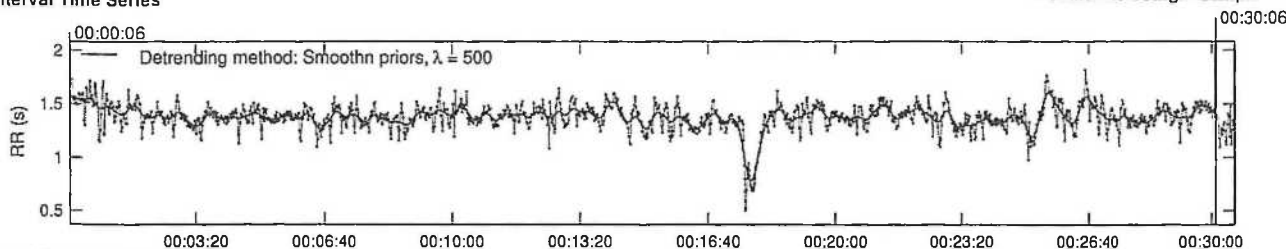
HRV Analysis Results

PEPSI loose hay 2 EDITED.txt - xx/xx/xx - xx:xx:xx

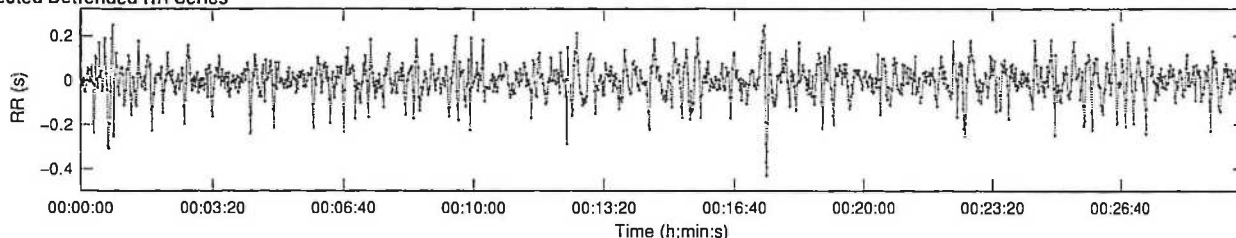
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RR Interval Time Series

Results for a single sample



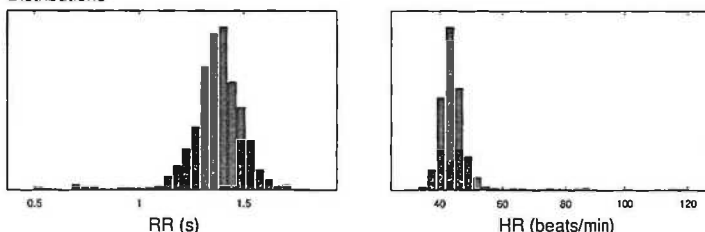
Selected Detrended RR Series



Time-Domain Results

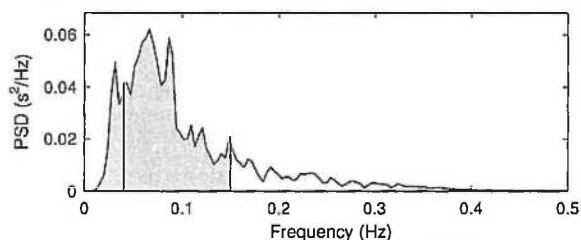
Variable	Units	Value
Mean RR*	(ms)	1366.7
STD RR (SDNN)	(ms)	80.5
Mean HR*	(1/min)	44.58
STD HR	(1/min)	5.33
RMSSD	(ms)	75.3
NN50	(count)	573
pNN50	(%)	43.2
RR triangular index		17.932
TINN	(ms)	500.0

Distributions*



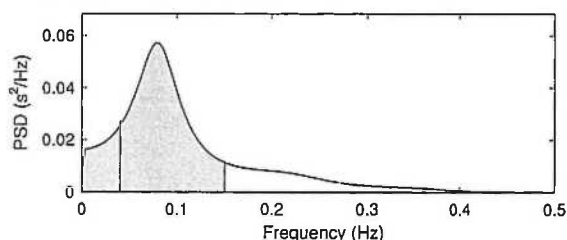
Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0313	677	12.6	
LF (0.04-0.15 Hz)	0.0664	3666	68.0	77.8
HF (0.15-0.4 Hz)	0.1523	1044	19.4	22.2
Total		5389		
LF/HF		3.510		

AR Spectrum (AR model order = 16, not factorized)

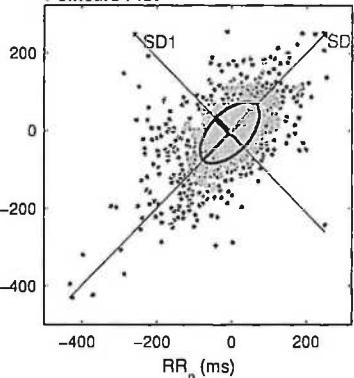


Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	747	13.4	
LF (0.04-0.15 Hz)	0.0781	3711	66.4	76.7
HF (0.15-0.4 Hz)	0.1523	1126	20.2	23.3
Total		5585		
LF/HF		3.296		

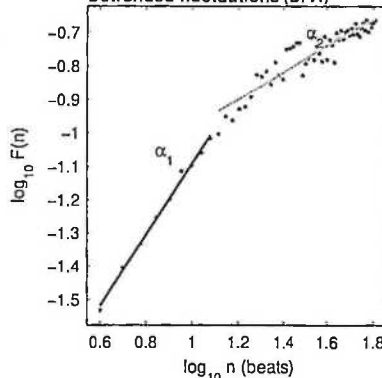
Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	53.3
SD2	(ms)	100.6
Recurrence plot		
Mean line length (Lmean)	(beats)	9.85
Max line length (Lmax)	(beats)	80
Recurrence rate (REC)	(%)	33.70
Determinism (DET)	(%)	97.86
Shannon Entropy (ShanEn)		3.105
Other		
Approximate entropy (ApEn)		1.469
Sample entropy (SampEn)		1.644
Detrended fluctuations (DFA): α_1		1.068
Detrended fluctuations (DFA): α_2		0.399
Correlation dimension (D2)		4.789
Multiscale entropy (MSE)		0.319 - 1.644

Poincare Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

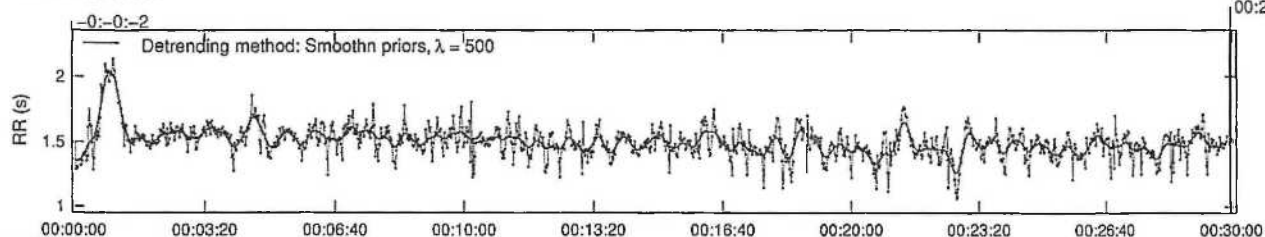
HRV Analysis Results

PEPSI loose hay day 14.txt - xx/xx/xx - xx:xx:xx

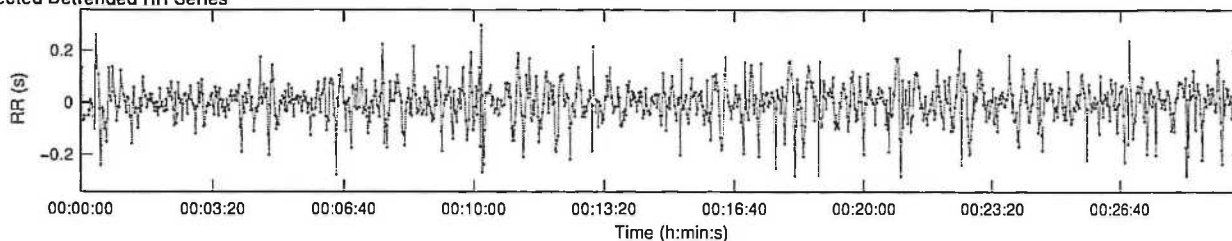
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RR Interval Time Series

Results for a single sample



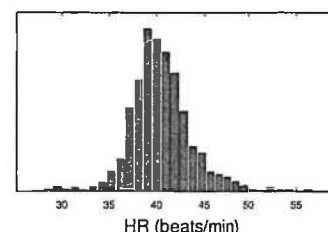
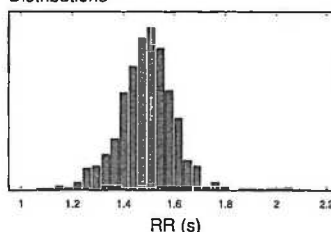
Selected Detrended RR Series



Time-Domain Results

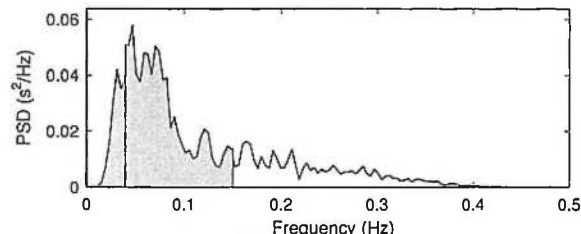
Variable	Units	Value
Mean RR*	(ms)	1492.0
STD RR (SDNN)	(ms)	75.7
Mean HR*	(1/min)	40.47
STD HR	(1/min)	2.93
RMSSD	(ms)	83.1
NN50	(count)	540
pNN50	(%)	44.4
RR triangular index		16.658
TINN	(ms)	430.0

Distributions*



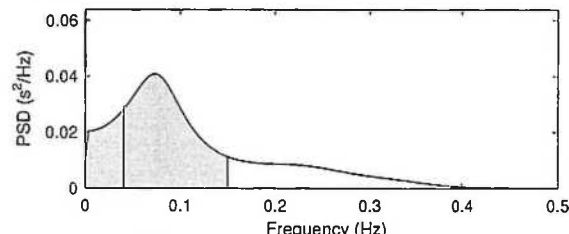
Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0313	638	12.8	
LF (0.04-0.15 Hz)	0.0469	2960	59.4	68.1
HF (0.15-0.4 Hz)	0.1641	1384	27.8	31.8
Total		4982		
LF/HF		2.139		

AR Spectrum (AR model order = 16, not factorized)

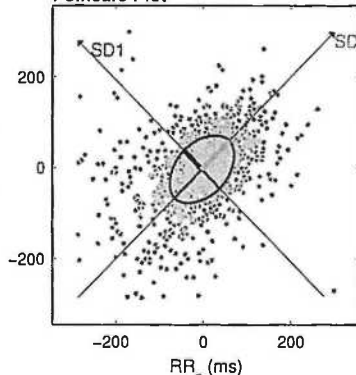


Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	888	16.7	
LF (0.04-0.15 Hz)	0.0742	3033	57.1	68.6
HF (0.15-0.4 Hz)	0.1523	1387	26.1	31.4
Total		5310		
LF/HF		2.186		

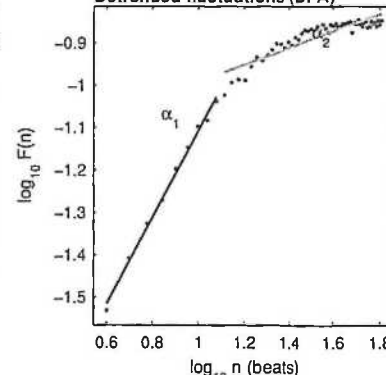
Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	58.8
SD2	(ms)	89.4
Recurrence plot		
Mean line length (Lmean)	(beats)	8.58
Max line length (Lmax)	(beats)	98
Recurrence rate (REC)	(%)	25.28
Determinism (DET)	(%)	96.78
Shannon Entropy (ShanEn)		2.937
Other		
Approximate entropy (ApEn)		1.565
Sample entropy (SampEn)		1.857
Detrended fluctuations (DFA): α1		1.020
Detrended fluctuations (DFA): α2		0.198
Correlation dimension (D2)		4.574
Multiscale entropy (MSE)		0.297 - 1.857

Poincare Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

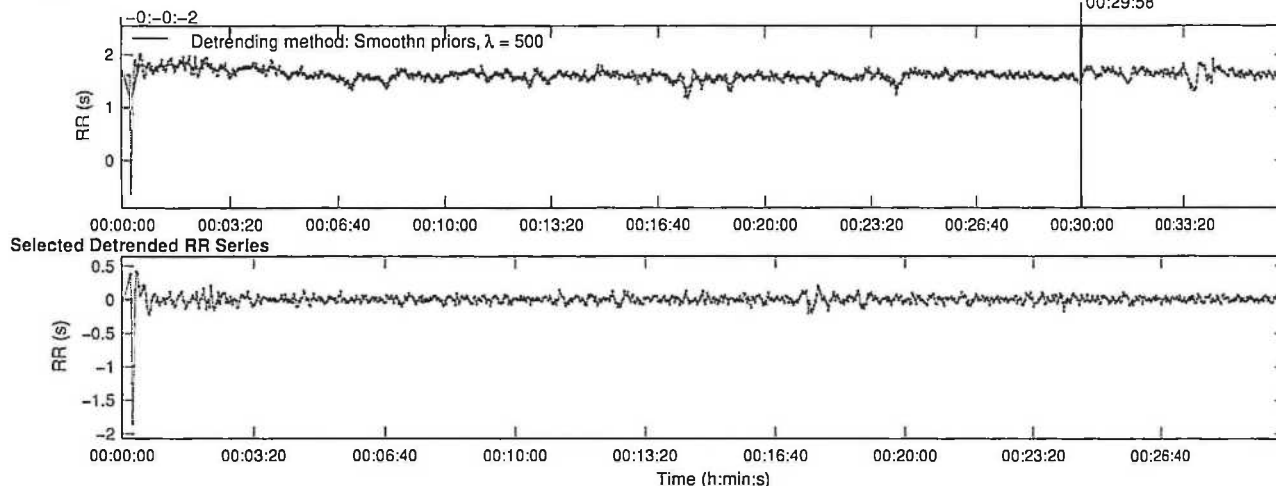
HRV Analysis Results

Pepsi Haynet day 1.txt - xx/xx/xx - xx:xx:xx

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RR Interval Time Series

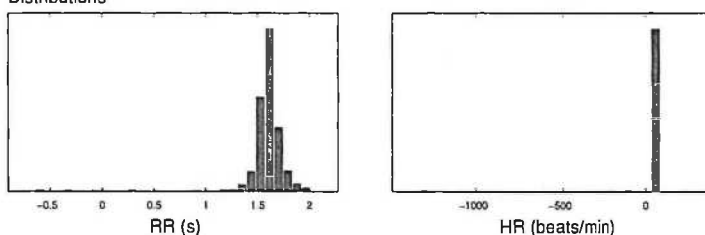
Results for a single sample
00:29:58



Time-Domain Results

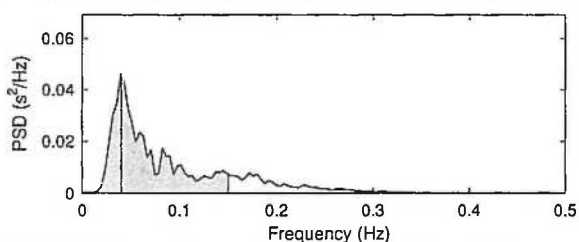
Variable	Units	Value
Mean RR*	(ms)	1601.6
STD RR (SDNN)	(ms)	118.0
Mean HR*	(1/min)	35.95
STD HR	(1/min)	41.01
RMSSD	(ms)	73.4
NN50	(count)	329
pNN50	(%)	29.3
RR triangular index		13.224
TINN	(ms)	1285.0

Distributions*



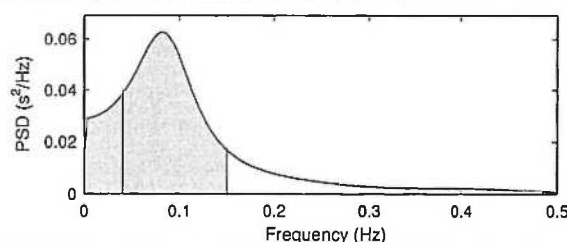
Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



Frequency Band	Peak (Hz)	Power (ms^2)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	517	20.9	
LF (0.04-0.15 Hz)	0.0430	1482	59.8	75.6
HF (0.15-0.4 Hz)	0.1719	477	19.3	24.4
Total		2476		
LF/HF		3.104		

AR Spectrum (AR model order = 16, not factorized)

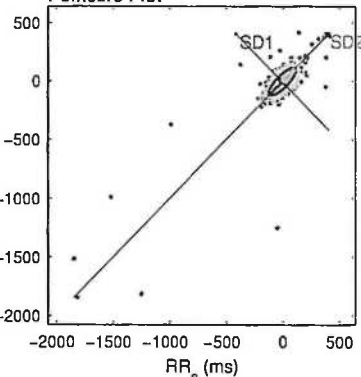


Frequency Band	Peak (Hz)	Power (ms^2)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	1255	17.1	
LF (0.04-0.15 Hz)	0.0820	4842	65.8	79.4
HF (0.15-0.4 Hz)	0.1523	1252	17.0	20.5
Total		7353		
LF/HF		3.866		

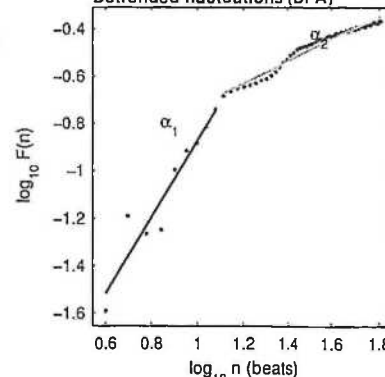
Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	51.9
SD2	(ms)	158.6
Recurrence plot		
Mean line length (Lmean)	(beats)	140.45
Max line length (Lmax)	(beats)	909
Recurrence rate (REC)	(%)	91.44
Determinism (DET)	(%)	99.86
Shannon Entropy (ShanEn)		5.409
Other		
Approximate entropy (ApEn)		1.160
Sample entropy (SampEn)		1.086
Detrended fluctuations (DFA): α_1		1.611
Detrended fluctuations (DFA): α_2		0.471
Correlation dimension (D2)		4.240
Multiscale entropy (MSE)		0.002 - 1.086

Poincare Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

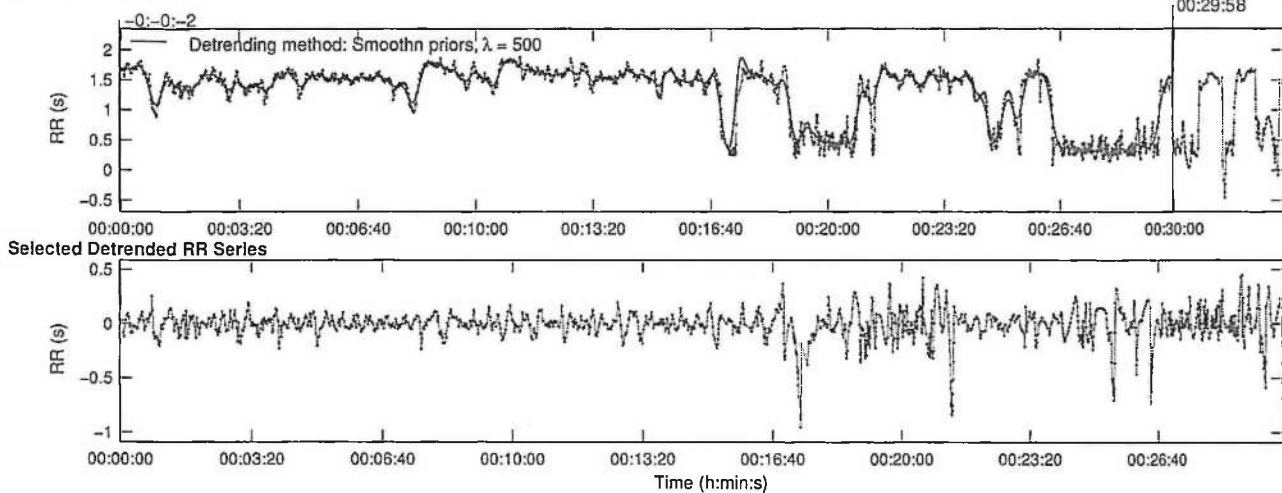
HRV Analysis Results

pepsi haynet day 2.txt -- xx/xx/xx -- xx:xx:xx

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RR Interval Time Series

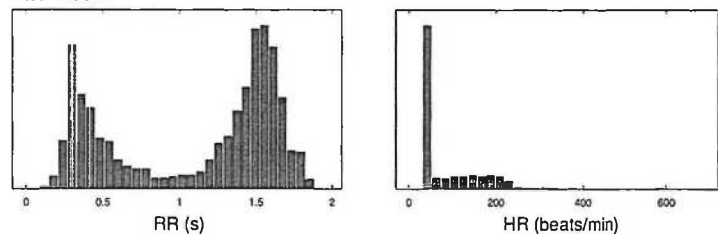
Results for a single sample



Time-Domain Results

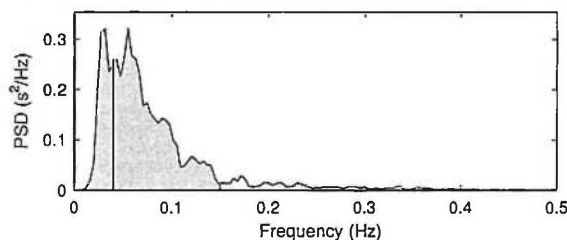
Variable	Units	Value
Mean RR*	(ms)	1098.8
STD RR (SDNN)	(ms)	162.2
Mean HR*	(1/min)	84.79
STD HR	(1/min)	40.55
RMSSD	(ms)	80.6
NN50	(count)	690
pNN50	(%)	44.4
RR triangular index		22.200
TINN	(ms)	980.0

Distributions*



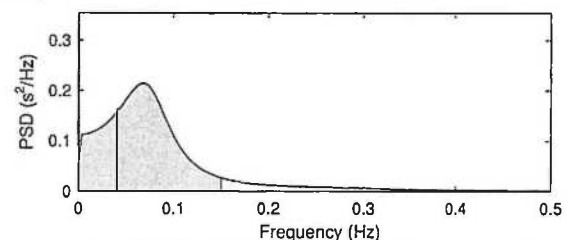
Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



Frequency Band	Peak (Hz)	Power (ms^2)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0313	5141	23.5	
LF (0.04-0.15 Hz)	0.0547	14815	67.8	88.6
HF (0.15-0.4 Hz)	0.1719	1904	8.7	11.4
Total		21861		
LF/HF		7.781		

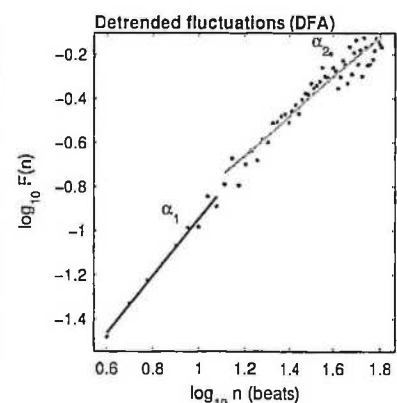
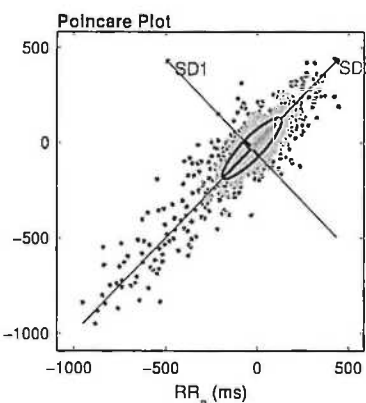
AR Spectrum (AR model order = 16, not factorized)



Frequency Band	Peak (Hz)	Power (ms^2)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	4917	23.8	
LF (0.04-0.15 Hz)	0.0664	13643	66.0	86.6
HF (0.15-0.4 Hz)	0.1523	2106	10.2	13.4
Total		20670		
LF/HF		6.477		

Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	57.0
SD2	(ms)	221.5
Recurrence plot		
Mean line length (Lmean)	(beats)	27.41
Max line length (Lmax)	(beats)	709
Recurrence rate (REC)	(%)	60.73
Determinism (DET)	(%)	99.68
Shannon Entropy (ShanEn)		4.076
Other		
Approximate entropy (ApEn)		1.148
Sample entropy (SampEn)		1.104
Detrended fluctuations (DFA): α_1		1.291
Detrended fluctuations (DFA): α_2		0.897
Correlation dimension (D2)		4.290
Multiscale entropy (MSE)		0.124 - 1.144



*Results are calculated from the non-detrended selected RR series.

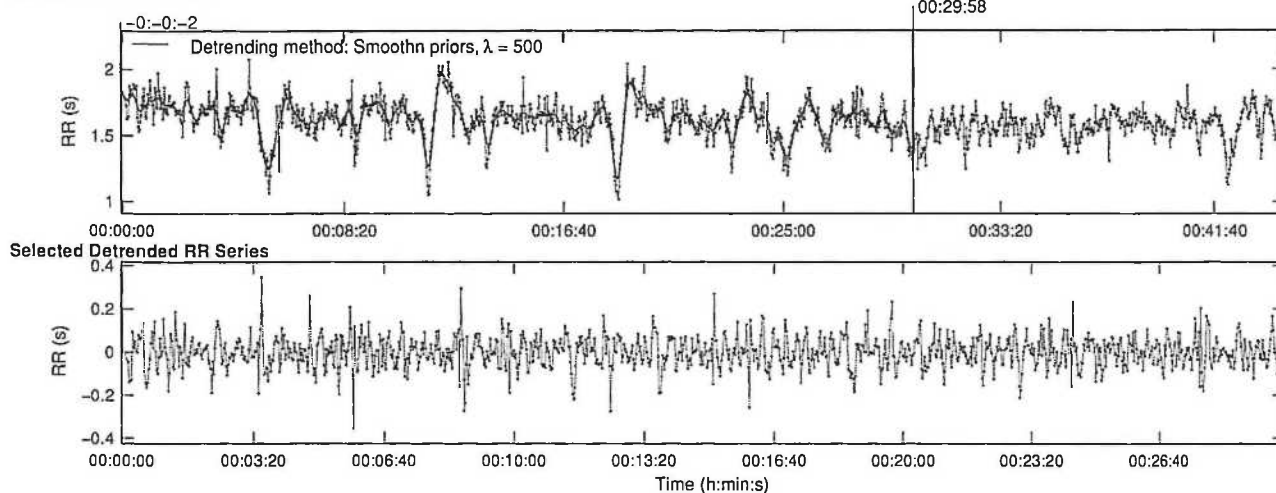
HRV Analysis Results

pepsi Hr data haynet day 3.txt - xx/xx/xx - xx:xx:xx

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RR Interval Time Series

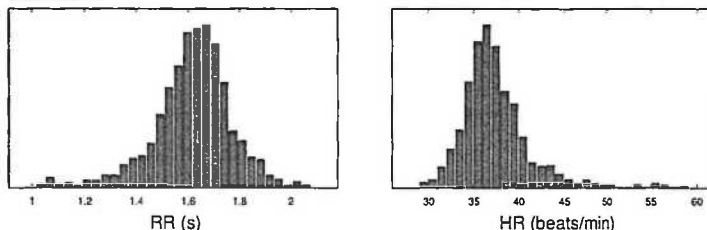
Results for a single sample



Time-Domain Results

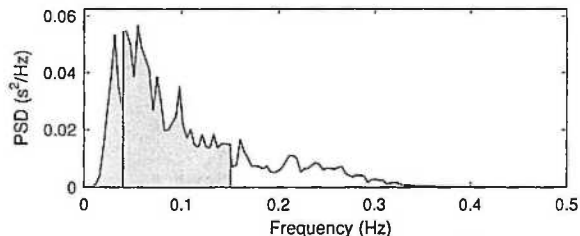
Variable	Units	Value
Mean RR*	(ms)	1616.4
STD RR (SDNN)	(ms)	73.6
Mean HR*	(1/min)	37.50
STD HR	(1/min)	3.64
RMSSD	(ms)	81.8
NN50	(count)	497
pNN50	(%)	44.8
RR triangular index		16.833
TINN	(ms)	500.0

Distributions*



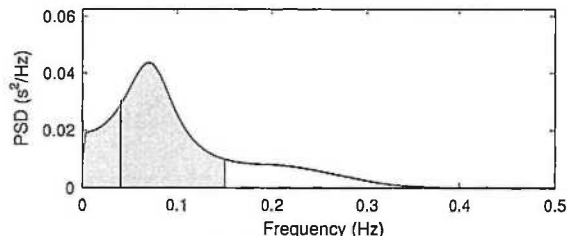
Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0313	754	15.4	
LF (0.04-0.15 Hz)	0.0547	3006	61.6	72.8
HF (0.15-0.4 Hz)	0.1602	1121	23.0	27.2
Total		4882		
LF/HF		2.681		

AR Spectrum (AR model order = 16, not factorized)

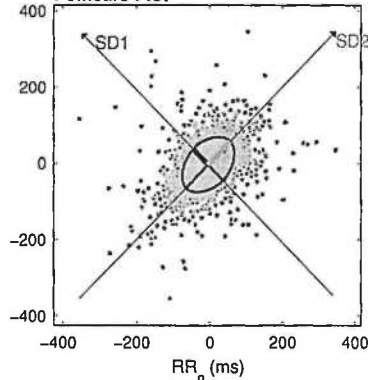


Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	868	17.7	
LF (0.04-0.15 Hz)	0.0703	2978	60.6	73.6
HF (0.15-0.4 Hz)	0.1523	1070	21.8	26.4
Total		4917		
LF/HF		2.784		

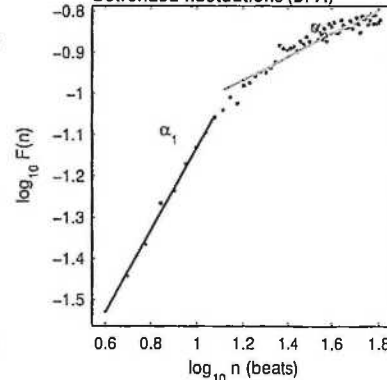
Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	57.9
SD2	(ms)	86.5
Recurrence plot		
Mean line length (Lmean)	(beats)	7.61
Max line length (Lmax)	(beats)	54
Recurrence rate (REC)	(%)	24.16
Determinism (DET)	(%)	96.21
Shannon Entropy (ShanEn)		2.791
Other		
Approximate entropy (ApEn)		1.545
Sample entropy (SampEn)		1.882
Detrended fluctuations (DFA): α1		1.002
Detrended fluctuations (DFA): α2		0.283
Correlation dimension (D2)		5.268
Multiscale entropy (MSE)		0.205 - 1.892

Poincare Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

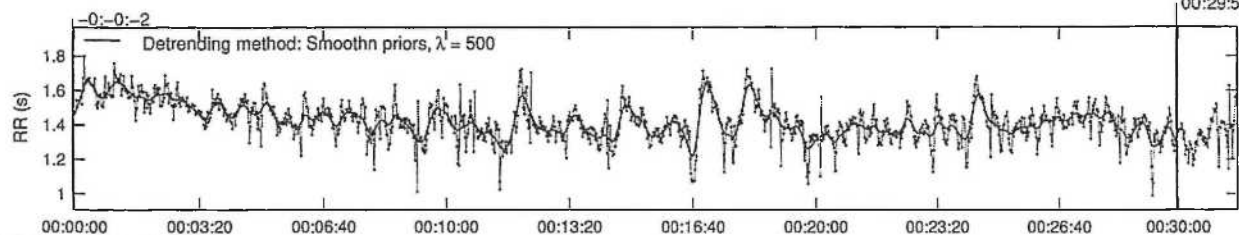
HRV Analysis Results

pepsi normal grid slow feeder 1.txt - xx/xx/xx - xx:xx:xx

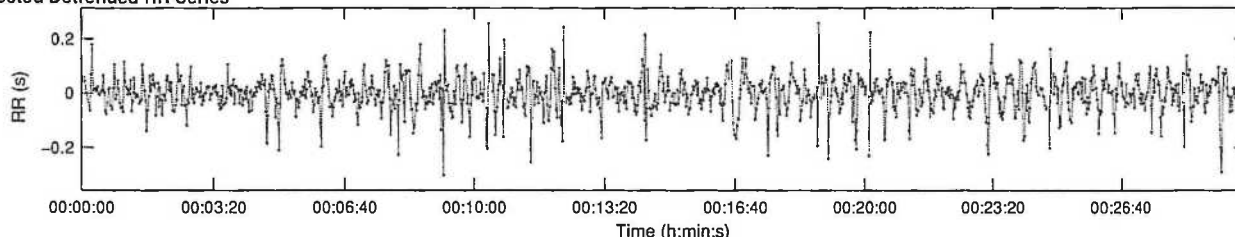
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RR Interval Time Series

Results for a single sample



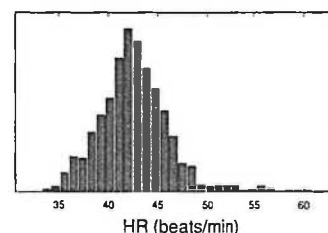
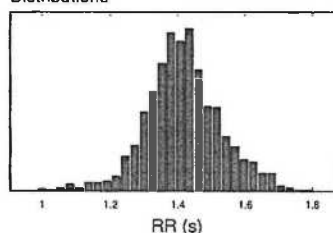
Selected Detrended RR Series



Time-Domain Results

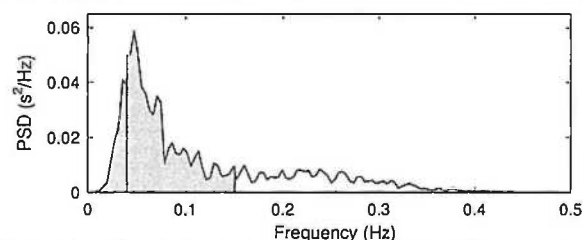
Variable	Units	Value
Mean RR*	(ms)	1415.9
STD RR (SDNN)	(ms)	65.0
Mean HR*	(1/min)	42.65
STD HR	(1/min)	2.92
RMSSD	(ms)	71.9
NN50	(count)	435
pNN50	(%)	34.3
RR triangular index		14.575
TINN	(ms)	405.0

Distributions*



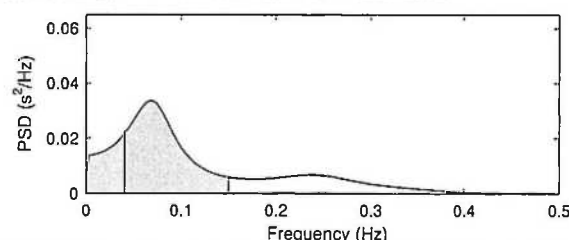
Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0352	509	13.4	
LF (0.04-0.15 Hz)	0.0469	2250	59.1	68.2
HF (0.15-0.4 Hz)	0.1602	1049	27.5	31.8
Total		3809		
LF/HF		2.145		

AR Spectrum (AR model order = 16, not factorized)

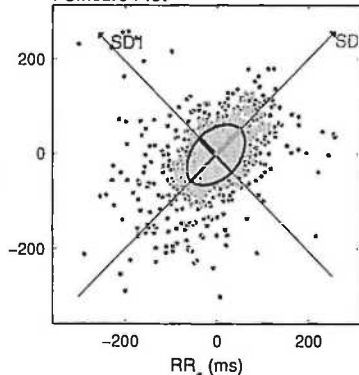


Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	629	16.8	
LF (0.04-0.15 Hz)	0.0664	2115	56.4	67.8
HF (0.15-0.4 Hz)	0.2383	1003	26.8	32.2
Total		3747		
LF/HF		2.109		

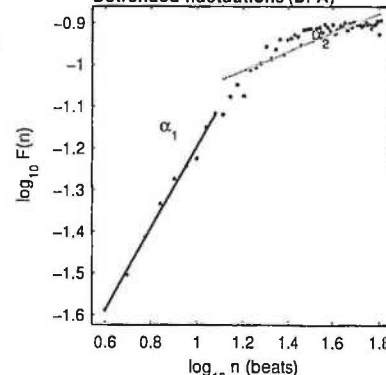
Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	50.9
SD2	(ms)	76.7
Recurrence plot		
Mean line length (Lmean)	(beats)	9.85
Max line length (Lmax)	(beats)	85
Recurrence rate (REC)	(%)	31.20
Determinism (DET)	(%)	97.98
Shannon Entropy (ShanEn)		3.107
Other		
Approximate entropy (ApEn)		1.473
Sample entropy (SampEn)		1.711
Detrended fluctuations (DFA): α1		0.982
Detrended fluctuations (DFA): α2		0.228
Correlation dimension (D2)		4.229
Multiscale entropy (MSE)		0.236 - 1.711

Poincare Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

HRV Analysis Results

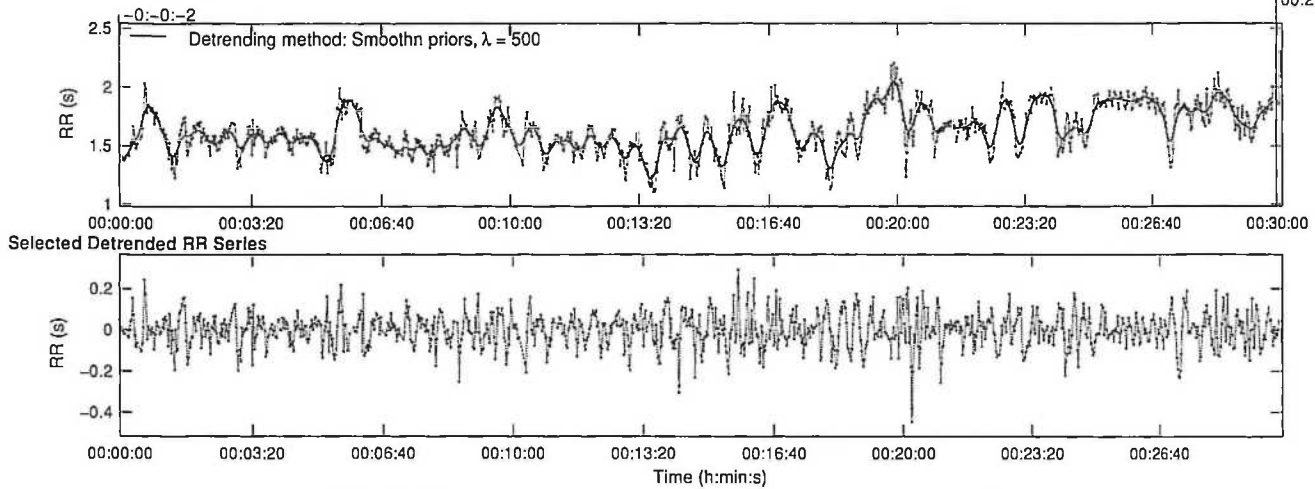
Pepsi data 2 normal grid slow feeder.txt - xx/xx/xx - xx:xx:xx

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RR Interval Time Series

Results for a single sample

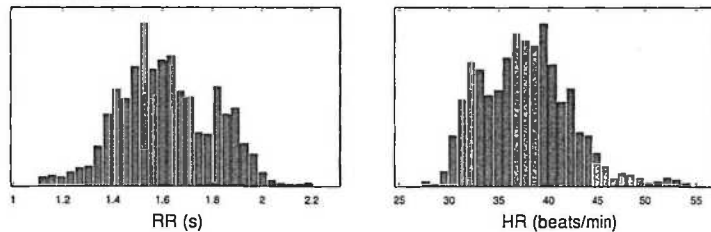
00:29:58



Time-Domain Results

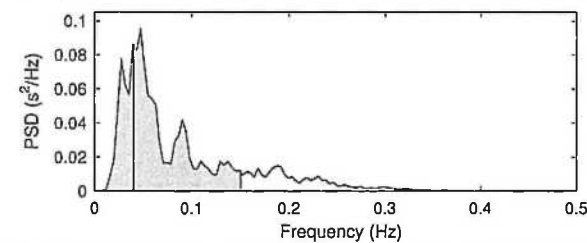
Variable	Units	Value
Mean RR*	(ms)	1614.5
STD RR (SDNN)	(ms)	82.7
Mean HR*	(1/min)	37.69
STD HR	(1/min)	3.68
RMSSD	(ms)	79.6
NN50	(count)	497
pNN50	(%)	45.5
RR triangular index		19.518
TINN	(ms)	535.0

Distributions*



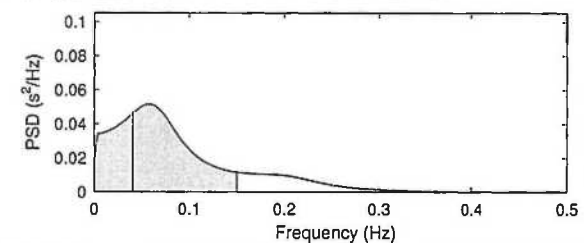
Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



Frequency Band	Peak (Hz)	Power (ms^2)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	1318	23.2	
LF (0.04-0.15 Hz)	0.0469	3322	58.5	76.3
HF (0.15-0.4 Hz)	0.1875	1035	18.2	23.7
Total		5675		
LF/HF		3.211		

AR Spectrum (AR model order = 16, not factorized)

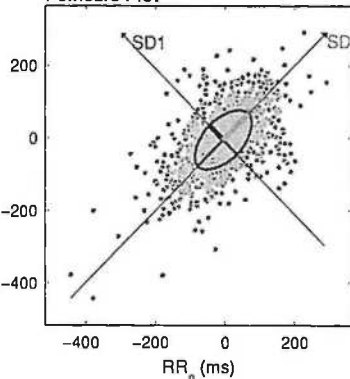


Frequency Band	Peak (Hz)	Power (ms^2)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	1492	25.1	
LF (0.04-0.15 Hz)	0.0586	3392	57.1	76.2
HF (0.15-0.4 Hz)	0.1523	1059	17.8	23.8
Total		5942		
LF/HF		3.204		

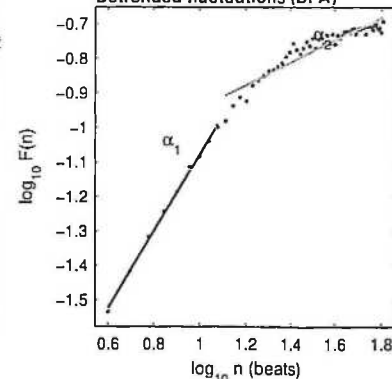
Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	56.3
SD2	(ms)	102.5
Recurrence plot		
Mean line length (Lmean)	(beats)	8.57
Max line length (Lmax)	(beats)	93
Recurrence rate (REC)	(%)	25.81
Determinism (DET)	(%)	97.09
Shannon Entropy (ShanEn)		2.938
Other		
Approximate entropy (ApEn)		1.526
Sample entropy (SampEn)		1.751
Detrended fluctuations (DFA): α_1		1.116
Detrended fluctuations (DFA): α_2		0.326
Correlation dimension (D2)		4.962
Multiscale entropy (MSE)		0.494 - 1.808

Poincare Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

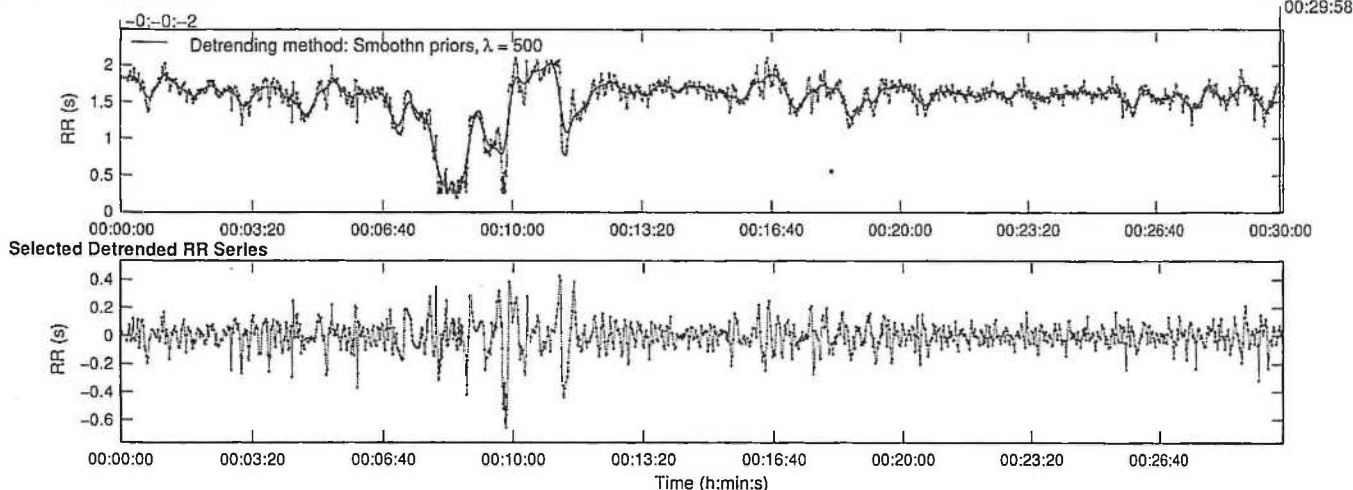
HRV Analysis Results

pepsi normal grid 3.txt - xx/xx/xx - xx:xx:xx

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RR Interval Time Series

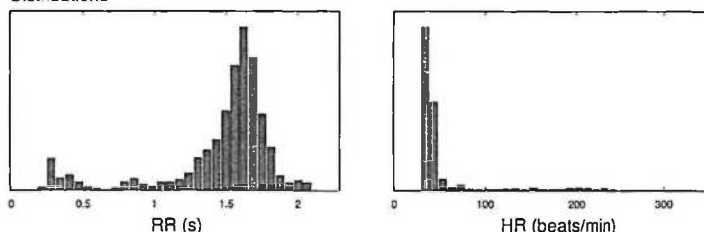
Results for a single sample



Time-Domain Results

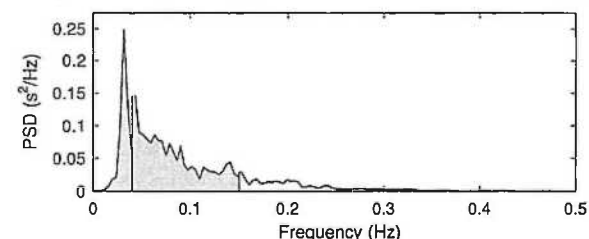
Variable	Units	Value
Mean RR*	(ms)	1459.8
STD RR (SDNN)	(ms)	118.8
Mean HR*	(1/min)	51.13
STD HR	(1/min)	21.89
RMSSD	(ms)	91.0
NN50	(count)	592
pNN50	(%)	48.0
RR triangular index		20.246
TINN	(ms)	765.0

Distributions*



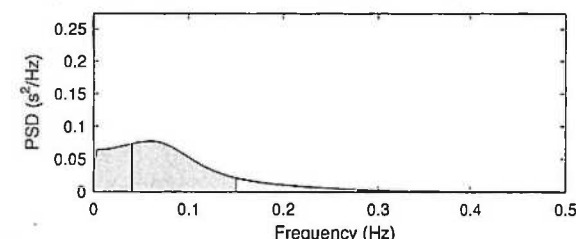
Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0313	2276	23.6	
LF (0.04-0.15 Hz)	0.0430	5879	61.0	79.9
HF (0.15-0.4 Hz)	0.1523	1480	15.4	20.1
Total		9637		
LF/HF		3.972		

AR Spectrum (AR model order = 16, not factorized)

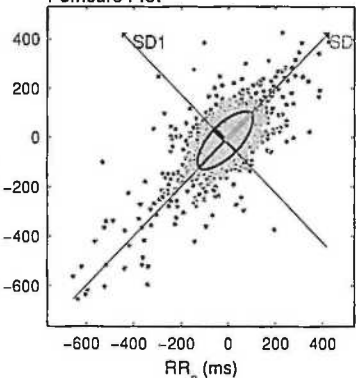


Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	2611	26.2	
LF (0.04-0.15 Hz)	0.0586	5923	59.5	80.7
HF (0.15-0.4 Hz)	0.1523	1412	14.2	19.2
Total		9946		
LF/HF		4.196		

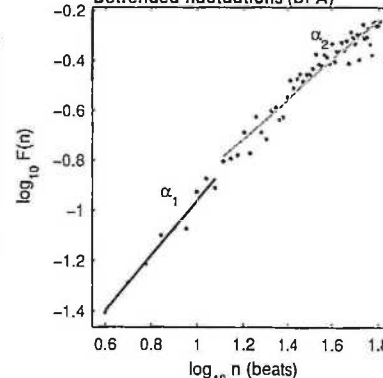
Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	64.4
SD2	(ms)	155.3
Recurrence plot		
Mean line length (Lmean)	(beats)	16.99
Max line length (Lmax)	(beats)	197
Recurrence rate (REC)	(%)	49.93
Determinism (DET)	(%)	99.20
Shannon Entropy (ShanEn)		3.700
Other		
Approximate entropy (ApEn)		1.355
Sample entropy (SampEn)		1.438
Detrended fluctuations (DFA): α1		1.099
Detrended fluctuations (DFA): α2		0.794
Correlation dimension (D2)		4.452
Multiscale entropy (MSE)		0.251 - 1.488

Poincare Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

HRV Analysis Results

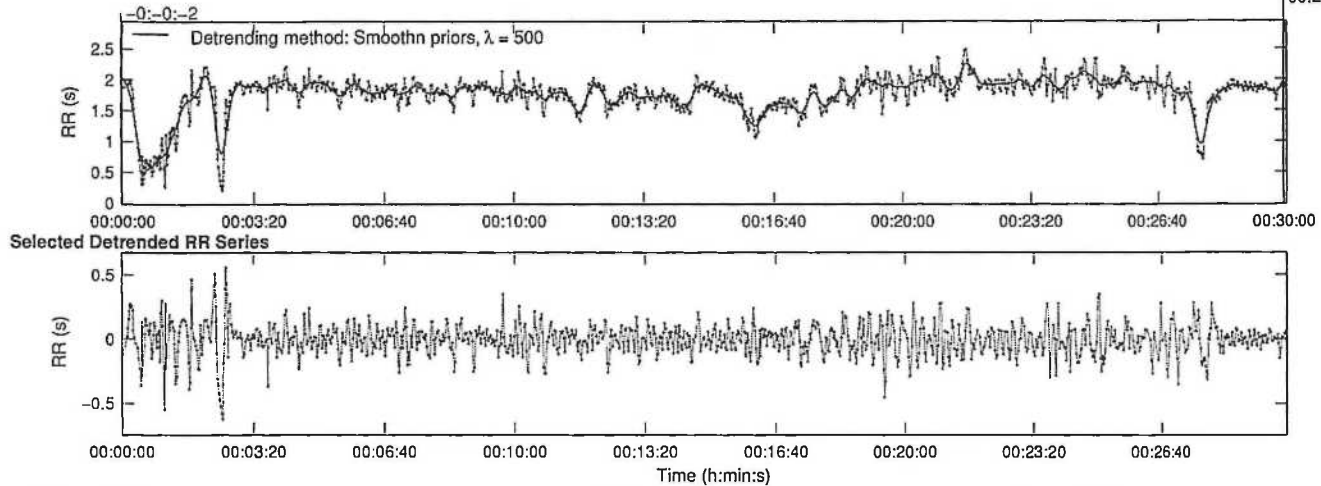
pepsi greedy grid 1.txt - xx/xx/xx - xx:xx:xx

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RR Interval Time Series

Results for a single sample

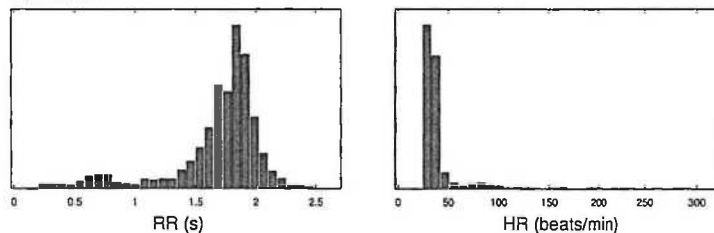
00:29:58



Time-Domain Results

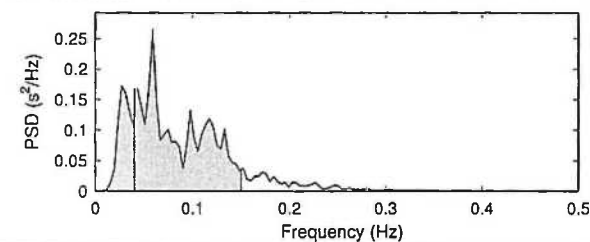
Variable	Units	Value
Mean RR*	(ms)	1680.4
STD RR (SDNN)	(ms)	136.3
Mean HR*	(1/min)	40.52
STD HR	(1/min)	19.92
RMSSD	(ms)	120.1
NN50	(count)	664
pNN50	(%)	62.8
RR triangular index		28.595
TINN	(ms)	855.0

Distributions*



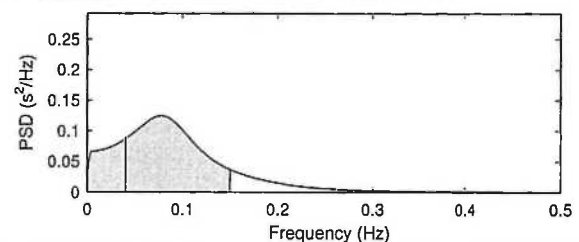
Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



Frequency Band	Peak (Hz)	Power (ms^2)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0273	2783	17.9	
LF (0.04-0.15 Hz)	0.0586	10915	70.4	85.8
HF (0.15-0.4 Hz)	0.1523	1810	11.7	14.2
Total		15508		
LF/HF		6.031		

AR Spectrum (AR model order = 16, not factorized)

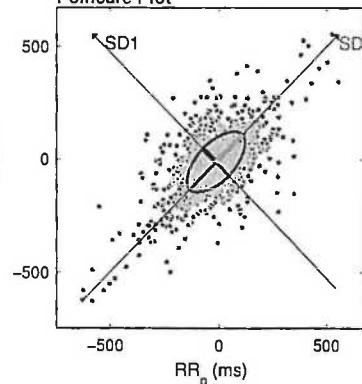


Frequency Band	Peak (Hz)	Power (ms^2)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	2843	19.2	
LF (0.04-0.15 Hz)	0.0781	9891	66.9	82.8
HF (0.15-0.4 Hz)	0.1523	2050	13.9	17.2
Total		14786		
LF/HF		4.824		

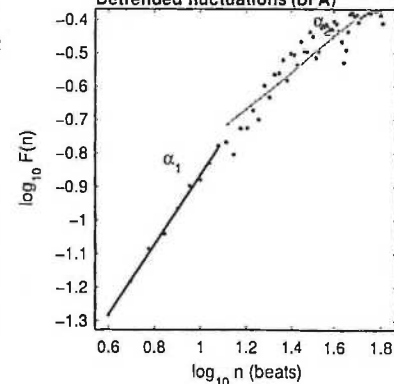
Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	84.9
SD2	(ms)	173.1
Recurrence plot		
Mean line length (Lmean)	(beats)	11.48
Max line length (Lmax)	(beats)	297
Recurrence rate (REC)	(%)	35.79
Determinism (DET)	(%)	97.93
Shannon Entropy (ShanEn)		3.276
Other		
Approximate entropy (ApEn)		1.431
Sample entropy (SampEn)		1.593
Detrended fluctuations (DFA): α_1		1.039
Detrended fluctuations (DFA): α_2		0.547
Correlation dimension (D2)		3.575
Multiscale entropy (MSE)		0.275 - 1.655

Poincare Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

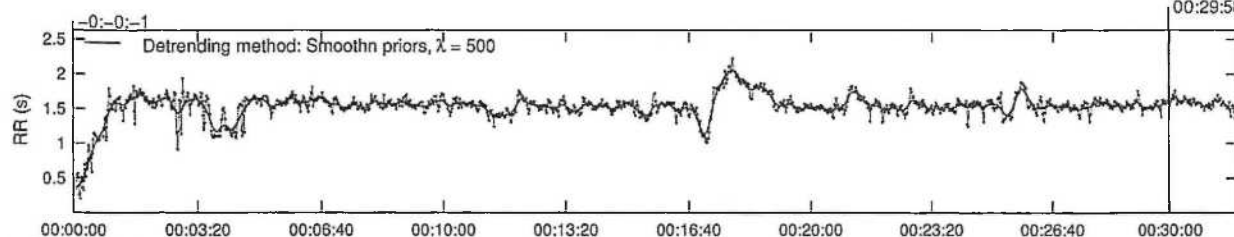
HRV Analysis Results

PEPSI SF GREEDY 2.txt - xx/xx/xx - xx:xx:xx

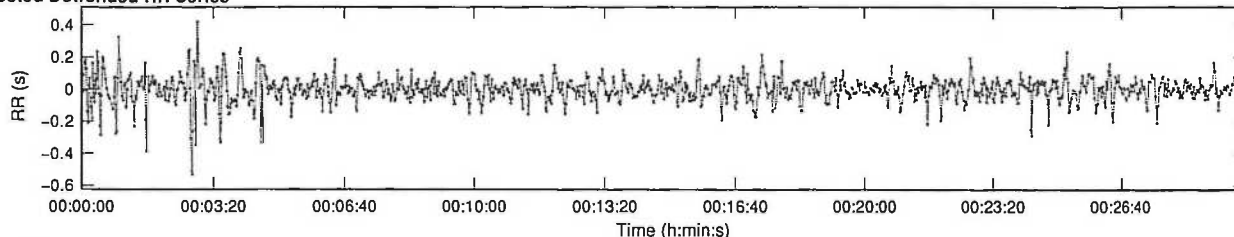
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RR Interval Time Series

Results for a single sample



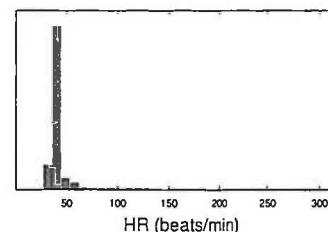
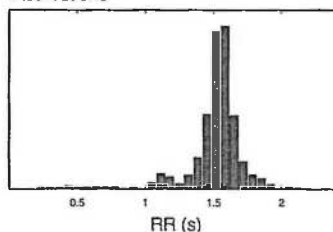
Selected Detrended RR Series



Time-Domain Results

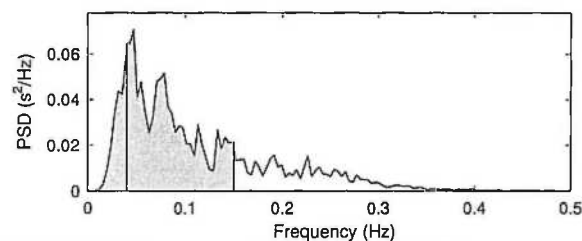
Variable	Units	Value
Mean RR*	(ms)	1506.9
STD RR (SDNN)	(ms)	80.8
Mean HR*	(1/min)	41.97
STD HR	(1/min)	8.28
RMSSD	(ms)	78.2
NN50	(count)	465
pNN50	(%)	38.3
RR triangular index		16.630
TINN	(ms)	655.0

Distributions*



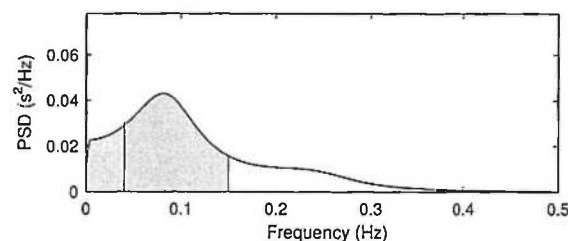
Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	763	13.6	
LF (0.04-0.15 Hz)	0.0469	3446	61.3	70.9
HF (0.15-0.4 Hz)	0.1914	1411	25.1	29.0
Total		5621		
LF/HF		2.442		

AR Spectrum (AR model order = 16, not factorized)

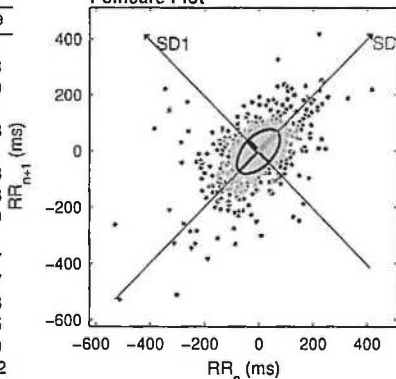


Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	964	15.9	
LF (0.04-0.15 Hz)	0.0820	3539	58.3	69.2
HF (0.15-0.4 Hz)	0.1523	1570	25.9	30.7
Total		6075		
LF/HF		2.253		

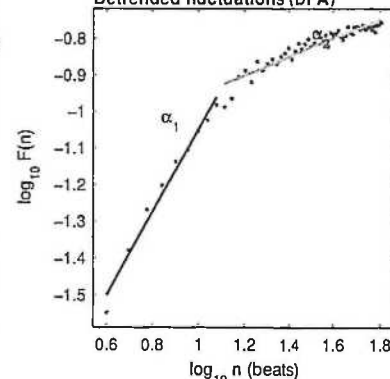
Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	55.3
SD2	(ms)	100.0
Recurrence plot		
Mean line length (Lmean)	(beats)	13.78
Max line length (Lmax)	(beats)	171
Recurrence rate (REC)	(%)	43.08
Determinism (DET)	(%)	98.58
Shannon Entropy (ShanEn)		3.460
Other		
Approximate entropy (ApEn)		1.427
Sample entropy (SampEn)		1.587
Detrended fluctuations (DFA): α1		1.128
Detrended fluctuations (DFA): α2		0.255
Correlation dimension (D2)		4.650
Multiscale entropy (MSE)		0.215 - 1.592

Poincare Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

HRV Analysis Results

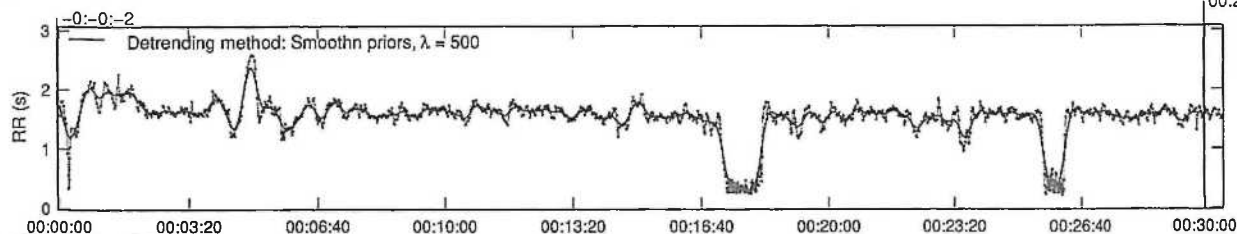
pepsi SF greedy 3.txt - xx/xx/xx - xx:xx:xx

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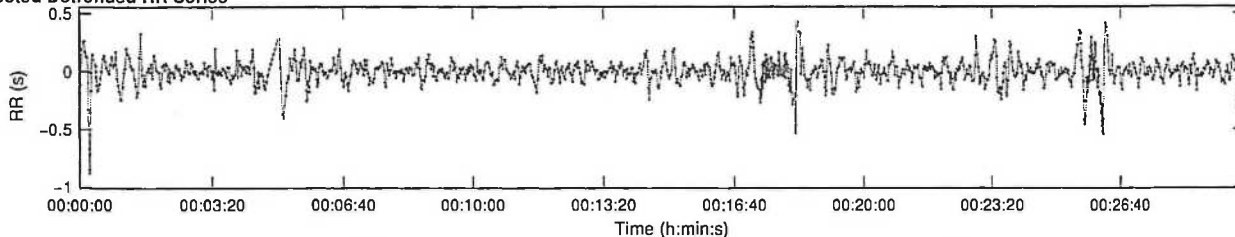
RR Interval Time Series

Results for a single sample

00:29:58



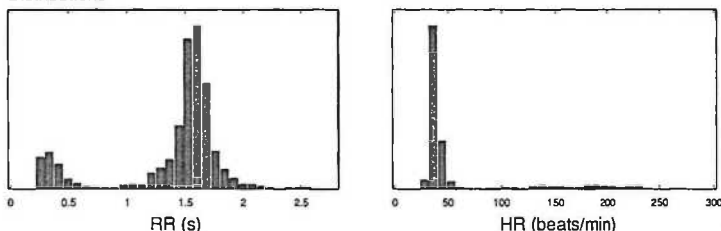
Selected Detrended RR Series



Time-Domain Results

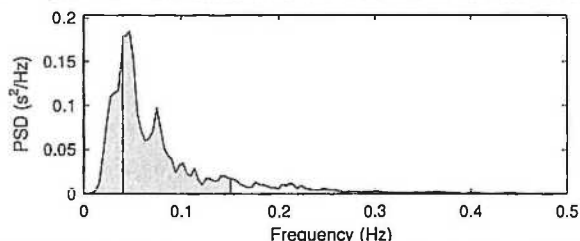
Variable	Units	Value
Mean RR*	(ms)	1394.9
STD RR (SDNN)	(ms)	117.7
Mean HR*	(1/min)	58.72
STD HR	(1/min)	22.50
RMSSD	(ms)	77.8
NN50	(count)	572
pNN50	(%)	43.4
RR triangular index		20.609
TINN	(ms)	900.0

Distributions*



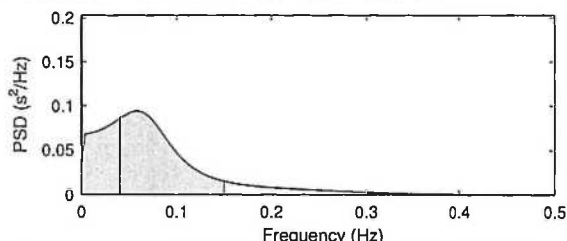
Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	2341	24.7	
LF (0.04-0.15 Hz)	0.0469	5979	63.2	84.0
HF (0.15-0.4 Hz)	0.1523	1137	12.0	16.0
Total		9459		
LF/HF		5.257		

AR Spectrum (AR model order = 16, not factorized)

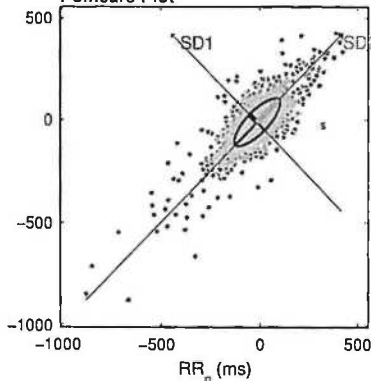


Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	2895	28.3	
LF (0.04-0.15 Hz)	0.0586	6142	60.1	83.9
HF (0.15-0.4 Hz)	0.1523	1180	11.5	16.1
Total		10217		
LF/HF		5.206		

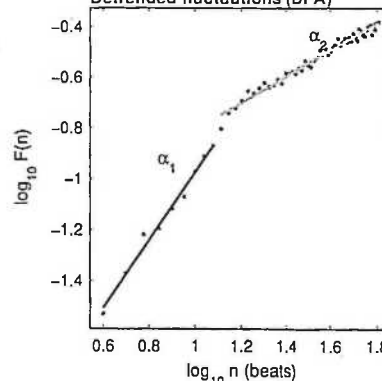
Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	55.0
SD2	(ms)	157.2
Recurrence plot		
Mean line length (Lmean)	(beats)	19.13
Max line length (Lmax)	(beats)	328
Recurrence rate (REC)	(%)	53.06
Determinism (DET)	(%)	99.24
Shannon Entropy (ShanEn)		3.789
Other		
Approximate entropy (ApEn)		1.384
Sample entropy (SampEn)		1.427
Detrended fluctuations (DFA): α1		1.333
Detrended fluctuations (DFA): α2		0.522
Correlation dimension (D2)		4.899
Multiscale entropy (MSE)		0.289 - 1.427

Poincare Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

HRV Analysis Results

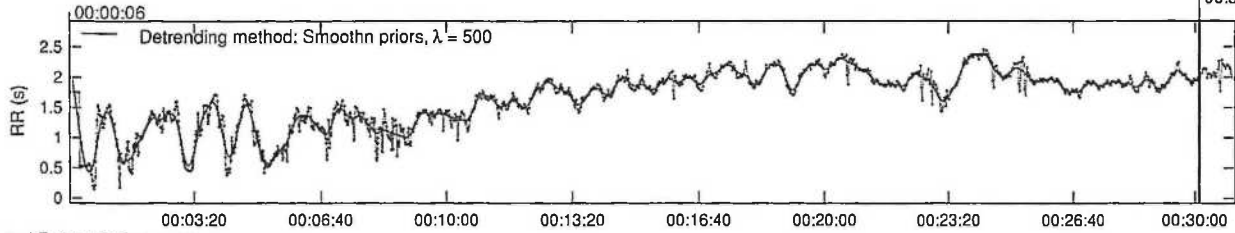
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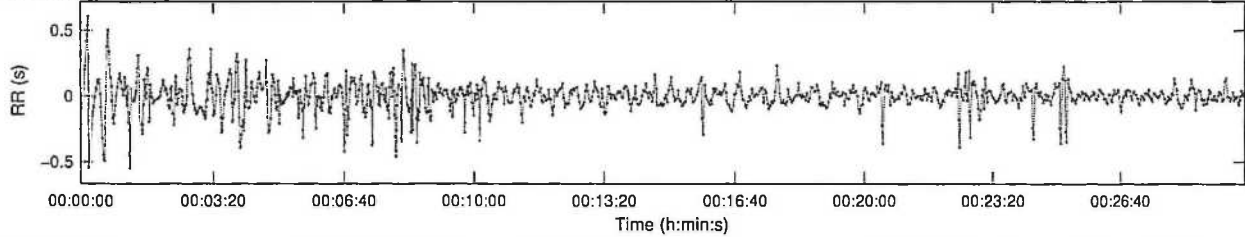
RR Interval Time Series

Results for a single sample

00:00:06 00:30:06



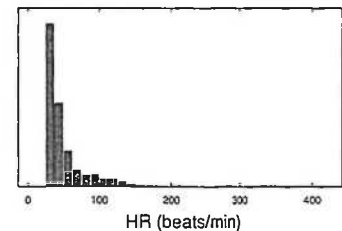
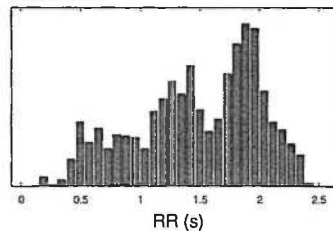
Selected Detrended RR Series



Time-Domain Results

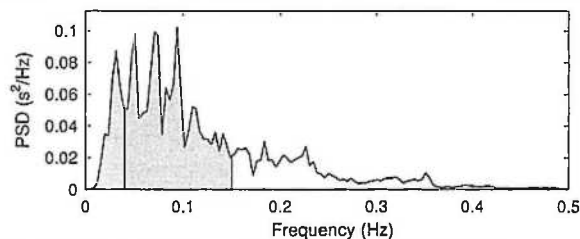
Variable	Units	Value
Mean RR*	(ms)	1479.6
STD RR (SDNN)	(ms)	121.5
Mean HR*	(1/min)	49.76
STD HR	(1/min)	24.28
RMSSD	(ms)	95.6
NN50	(count)	479
pNN50	(%)	37.8
RR triangular index		20.770
TINN	(ms)	810.0

Distributions*

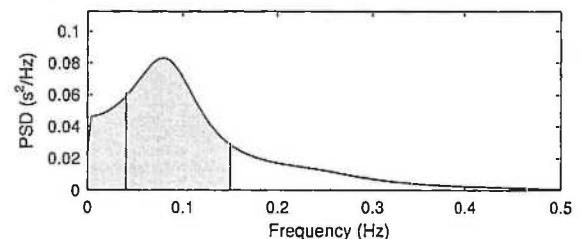


Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



AR Spectrum (AR model order = 16, not factorized)



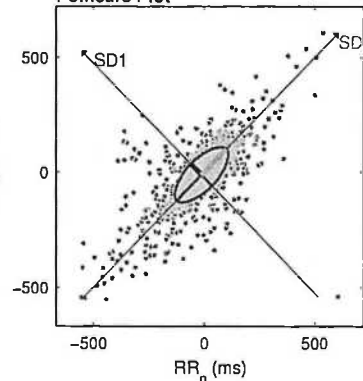
Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0313	1364	14.0	
LF (0.04-0.15 Hz)	0.0938	5799	59.4	69.0
HF (0.15-0.4 Hz)	0.1836	2599	26.6	30.9
Total		9766		
LF/HF		2.232		

Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	1973	17.2	
LF (0.04-0.15 Hz)	0.0781	6829	59.5	71.8
HF (0.15-0.4 Hz)	0.1523	2680	23.3	28.2
Total		11487		
LF/HF		2.548		

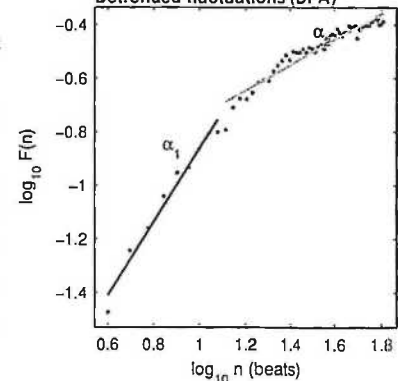
Nonlinear Results

Variable	Units	Value
Polnare plot		
SD1	(ms)	67.6
SD2	(ms)	157.8
Recurrence plot		
Mean line length (Lmean)	(beats)	15.49
Max line length (Lmax)	(beats)	302
Recurrence rate (REC)	(%)	44.70
Determinism (DET)	(%)	99.18
Shannon Entropy (ShanEn)		3.532
Other		
Approximate entropy (ApEn)		1.163
Sample entropy (SampEn)		1.116
Detrended fluctuations (DFA): α1		1.375
Detrended fluctuations (DFA): α2		0.477
Correlation dimension (D2)		3.979
Multiscale entropy (MSE)		0.409 - 1.370

Polnare Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

HRV Analysis Results

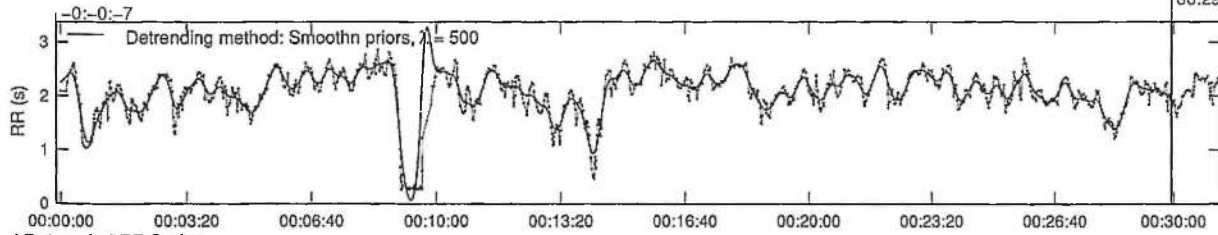
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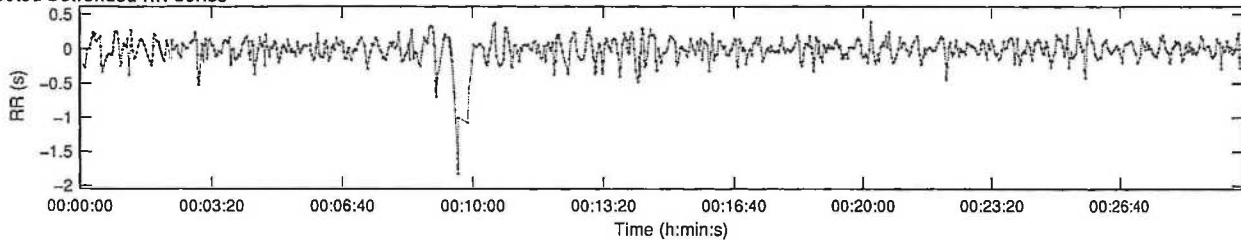
RR Interval Time Series

Results for a single sample

00:29:56



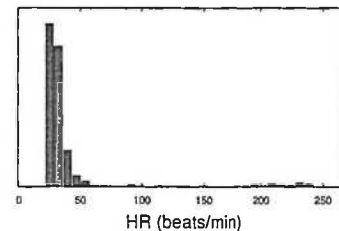
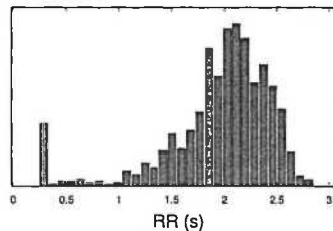
Selected Detrended RR Series



Time-Domain Results

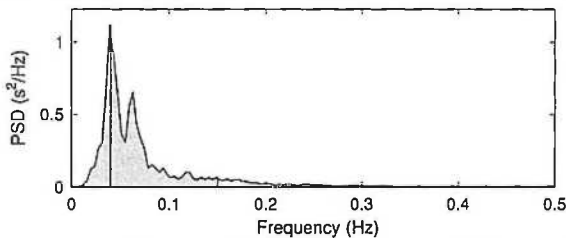
Variable	Units	Value
Mean RR*	(ms)	1949.4
STD RR (SDNN)	(ms)	209.1
Mean HR*	(1/min)	39.04
STD HR	(1/min)	23.76
RMSSD	(ms)	121.0
NN50	(count)	579
pNN50	(%)	60.0
RR triangular index		34.500
TINN	(ms)	1340.0

Distributions*



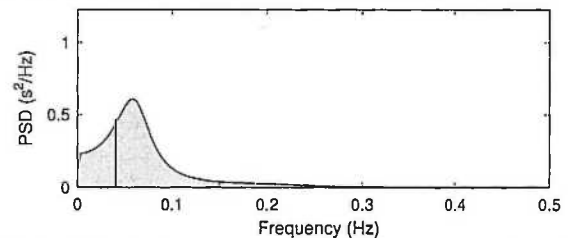
Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



Frequency Band	Peak (Hz)	Power (ms ²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	9264	24.8	
LF (0.04-0.15 Hz)	0.0430	24707	66.3	88.2
HF (0.15-0.4 Hz)	0.1602	3317	8.9	11.8
Total		37289		
LF/HF		7.450		

AR Spectrum (AR model order = 16, not factorized)

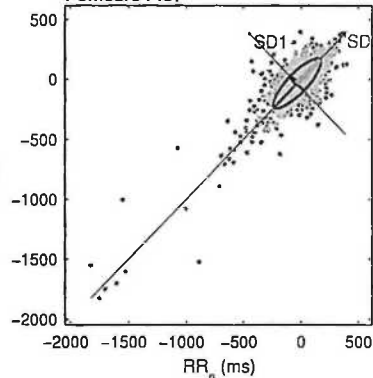


Frequency Band	Peak (Hz)	Power (ms ²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	11394	26.9	
LF (0.04-0.15 Hz)	0.0586	27941	66.1	90.4
HF (0.15-0.4 Hz)	0.1523	2961	7.0	9.6
Total		42298		
LF/HF		9.435		

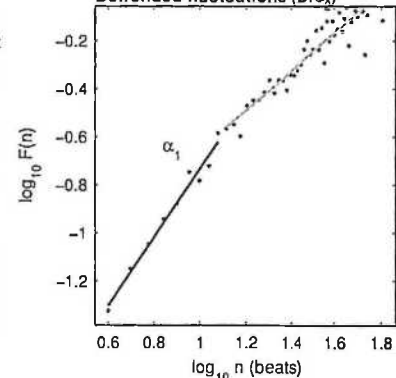
Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	85.6
SD2	(ms)	283.2
Recurrence plot		
Mean line length (Lmean)	(beats)	20.74
Max line length (Lmax)	(beats)	276
Recurrence rate (REC)	(%)	61.69
Determinism (DET)	(%)	99.46
Shannon Entropy (ShanEn)		3.904
Other		
Approximate entropy (ApEn)		1.238
Sample entropy (SampEn)		1.198
Detrended fluctuations (DFA): α_1		1.427
Detrended fluctuations (DFA): α_2		0.811
Correlation dimension (D2)		3.715
Multiscale entropy (MSE)		0.256 - 1.397

Poincare Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

HRV Analysis Results

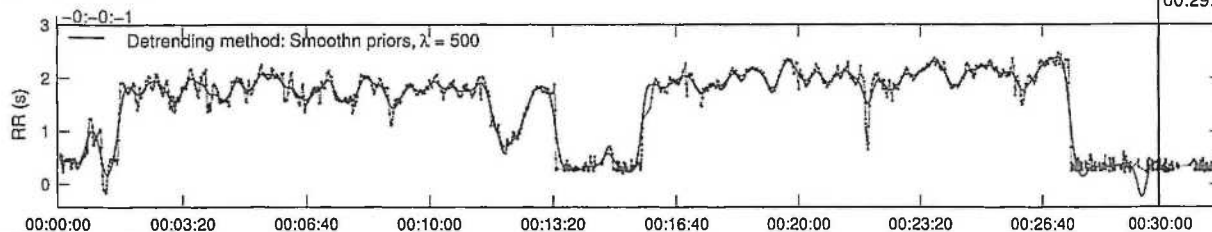
rupert baseline 3.txt - xx/xx/xx - xx:xx:xx

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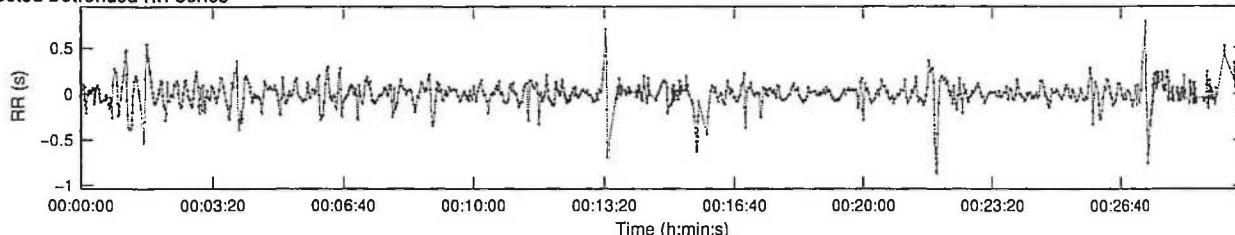
RR Interval Time Series

Results for a single sample

00:29:59



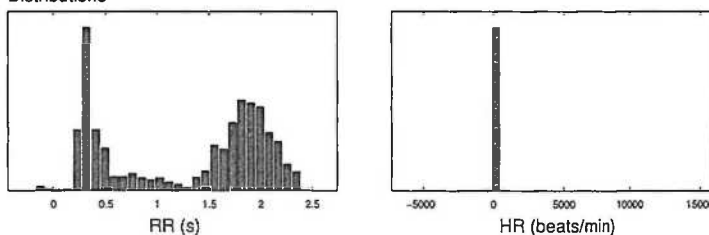
Selected Detrended RR Series



Time-Domain Results

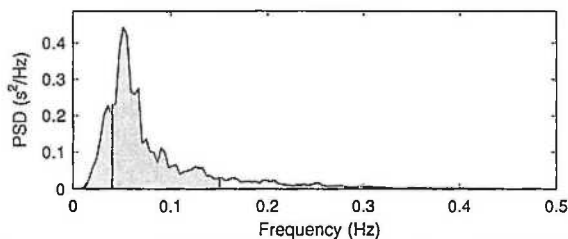
Variable	Units	Value
Mean RR*	(ms)	1281.7
STD RR (SDNN)	(ms)	161.2
Mean HR*	(1/min)	89.94
STD HR	(1/min)	414.55
RMSSD	(ms)	93.6
NN50	(count)	560
pNN50	(%)	42.2
RR triangular index		24.145
TINN	(ms)	1145.0

Distributions*



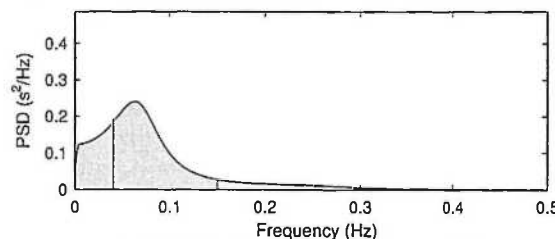
Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0352	3437	16.7	
LF (0.04-0.15 Hz)	0.0508	14654	71.3	85.7
HF (0.15-0.4 Hz)	0.1523	2444	11.9	14.3
Total		20538		
LF/HF		5.995		

AR Spectrum (AR model order = 16, not factorized)

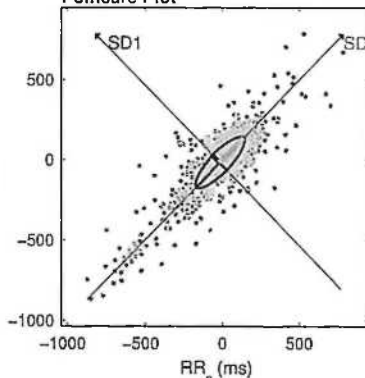


Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	5552	25.1	
LF (0.04-0.15 Hz)	0.0625	14177	64.0	85.5
HF (0.15-0.4 Hz)	0.1523	2405	10.9	14.5
Total		22138		
LF/HF		5.895		

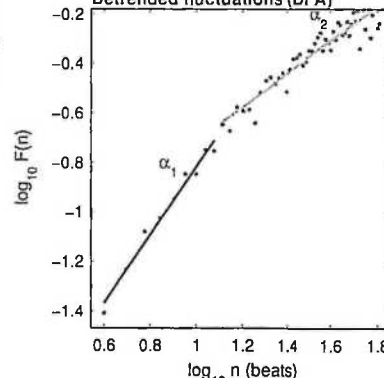
Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	66.2
SD2	(ms)	218.3
Recurrence plot		
Mean line length (Lmean)	(beats)	22.64
Max line length (Lmax)	(beats)	275
Recurrence rate (REC)	(%)	59.28
Determinism (DET)	(%)	99.65
Shannon Entropy (ShanEn)		4.006
Other		
Approximate entropy (ApEn)		1.071
Sample entropy (SampEn)		0.968
Detrended fluctuations (DFA): α1		1.375
Detrended fluctuations (DFA): α2		0.675
Correlation dimension (D2)		3.877
Multiscale entropy (MSE)		0.433 - 1.244

Poincare Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

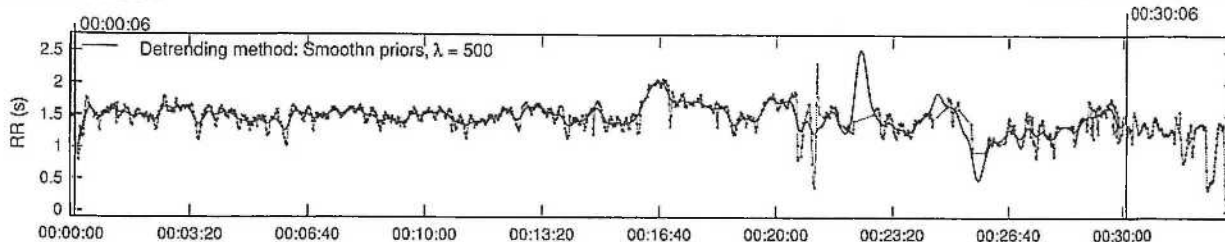
HRV Analysis Results

RUPERT loose hay 1.txt - xx/xx/xx - xx:xx:xx

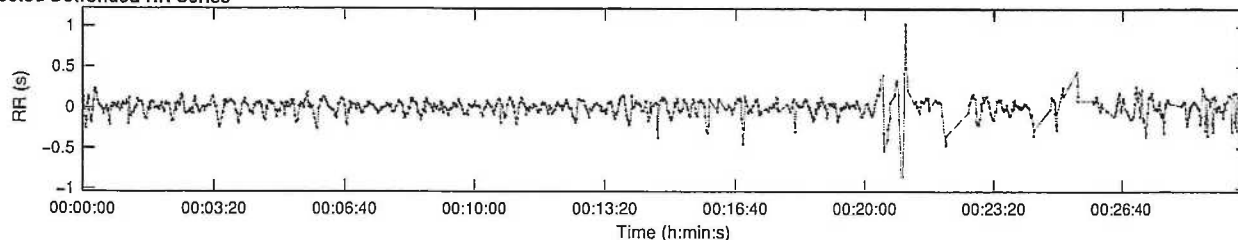
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RR Interval Time Series

Results for a single sample



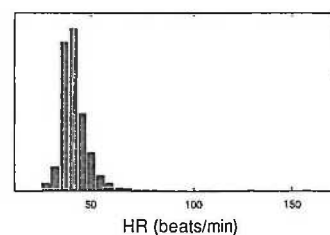
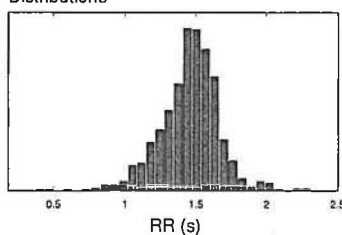
Selected Detrended RR Series



Time-Domain Results

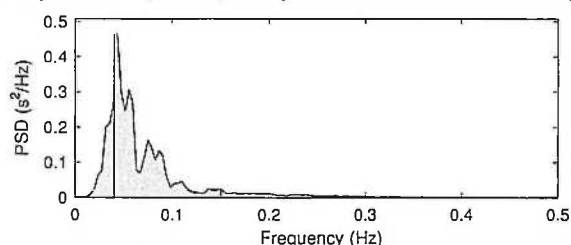
Variable	Units	Value
Mean RR*	(ms)	1458.9
STD RR (SDNN)	(ms)	132.7
Mean HR*	(1/min)	42.15
STD HR	(1/min)	6.92
RMSSD	(ms)	86.3
NN50	(count)	417
pNN50	(%)	35.3
RR triangular index		21.889
TINN	(ms)	1280.0

Distributions*

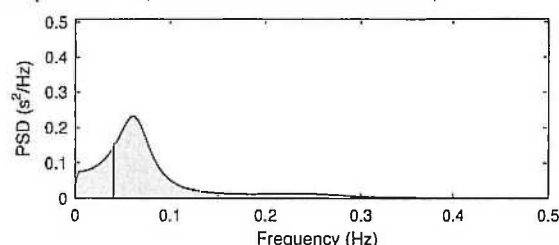


Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



AR Spectrum (AR model order = 16, not factorized)



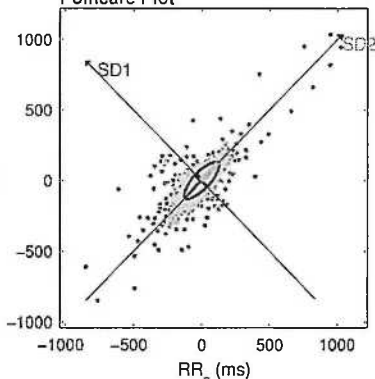
Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	3075	19.1	
LF (0.04-0.15 Hz)	0.0430	11660	72.4	89.6
HF (0.15-0.4 Hz)	0.1523	1358	8.4	10.4
Total		16094		
LF/HF		8.583		

Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	3698	22.6	
LF (0.04-0.15 Hz)	0.0625	10716	65.5	84.6
HF (0.15-0.4 Hz)	0.1523	1954	11.9	15.4
Total		16370		
LF/HF		5.484		

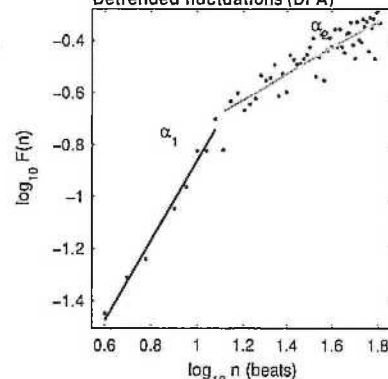
Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	61.1
SD2	(ms)	177.4
Recurrence plot		
Mean line length (Lmean)	(beats)	23.79
Max line length (Lmax)	(beats)	551
Recurrence rate (REC)	(%)	62.73
Determinism (DET)	(%)	99.66
Shannon Entropy (ShanEn)		4.038
Other		
Approximate entropy (ApEn)		1.151
Sample entropy (SampEn)		1.094
Detrended fluctuations (DFA): α1		1.534
Detrended fluctuations (DFA): α2		0.503
Correlation dimension (D2)		3.975
Multiscale entropy (MSE)		0.231 - 1.264

Poincare Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

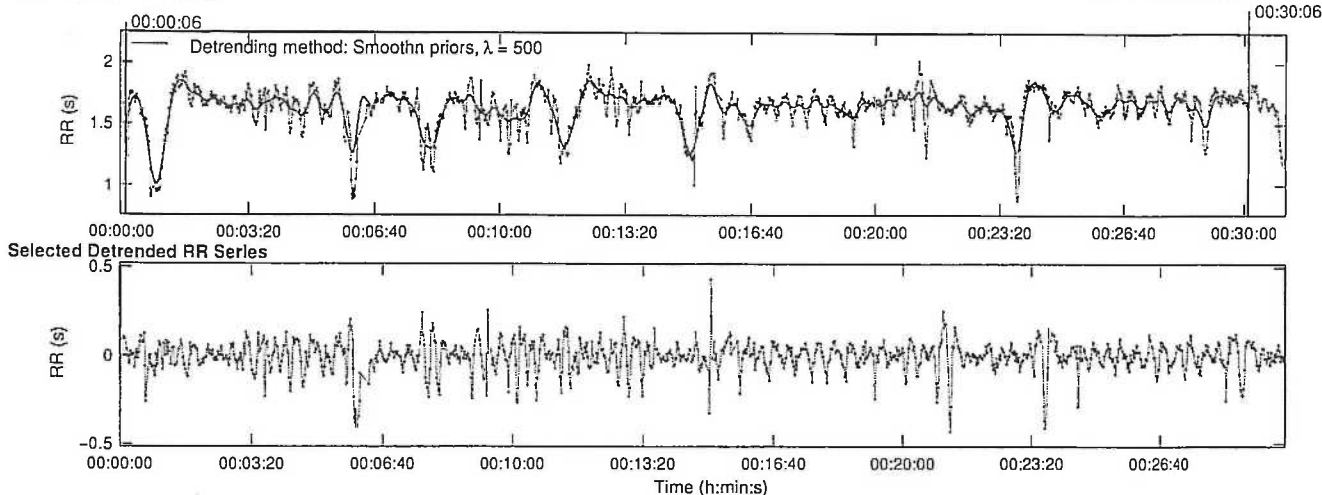
HRV Analysis Results

RUPERT loose hay 2.txt - xx/xx/xx - xx:xx:xx

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RR Interval Time Series

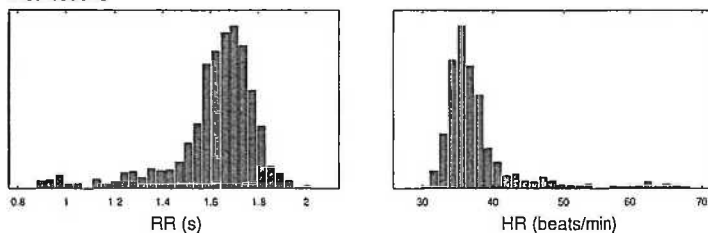
Results for a single sample



Time-Domain Results

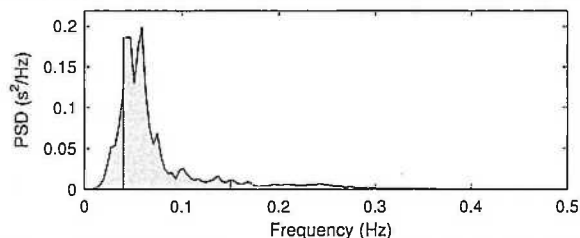
Variable	Units	Value
Mean RR*	(ms)	1616.3
STD RR (SDNN)	(ms)	92.7
Mean HR*	(1/min)	37.77
STD HR	(1/min)	5.11
RMSSD	(ms)	70.5
NN50	(count)	373
pNN50	(%)	33.3
RR triangular index		18.081
TINN	(ms)	615.0

Distributions*



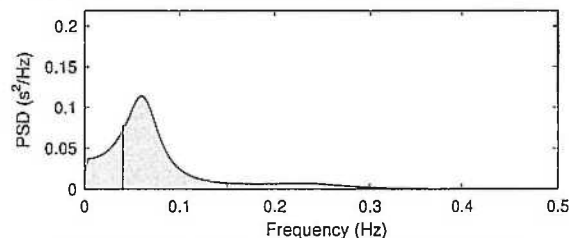
Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



Frequency Band	Peak (Hz)	Power (ms^2)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	1239	15.5	
LF (0.04-0.15 Hz)	0.0586	5968	74.6	88.3
HF (0.15-0.4 Hz)	0.1523	787	9.8	11.7
Total		7994		
LF/HF		7.580		

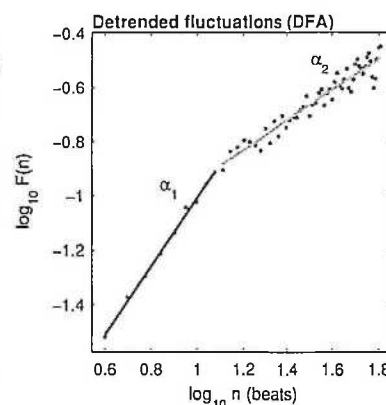
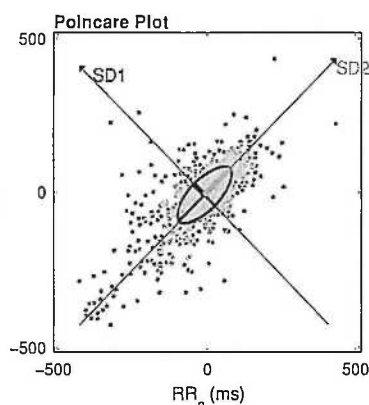
AR Spectrum (AR model order = 16, not factorized)



Frequency Band	Peak (Hz)	Power (ms^2)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	1824	23.1	
LF (0.04-0.15 Hz)	0.0586	5178	65.6	85.3
HF (0.15-0.4 Hz)	0.1523	891	11.3	14.7
Total		7893		
LF/HF		5.810		

Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	49.9
SD2	(ms)	121.3
Recurrence plot		
Mean line length (Lmean)	(beats)	15.54
Max line length (Lmax)	(beats)	203
Recurrence rate (REC)	(%)	45.24
Determinism (DET)	(%)	99.12
Shannon Entropy (ShanEn)		3.609
Other		
Approximate entropy (ApEn)		1.317
Sample entropy (SampEn)		1.403
Detrended fluctuations (DFA): α_1		1.257
Detrended fluctuations (DFA): α_2		0.564
Correlation dimension (D2)		3.676
Multiscale entropy (MSE)		0.434 - 1.417



*Results are calculated from the non-detrended selected RR series.

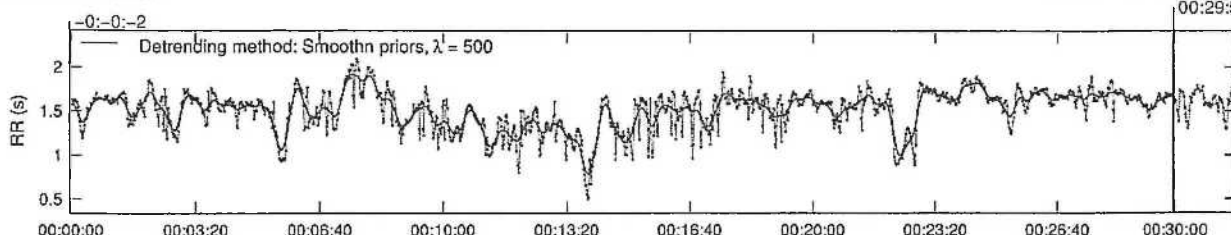
HRV Analysis Results

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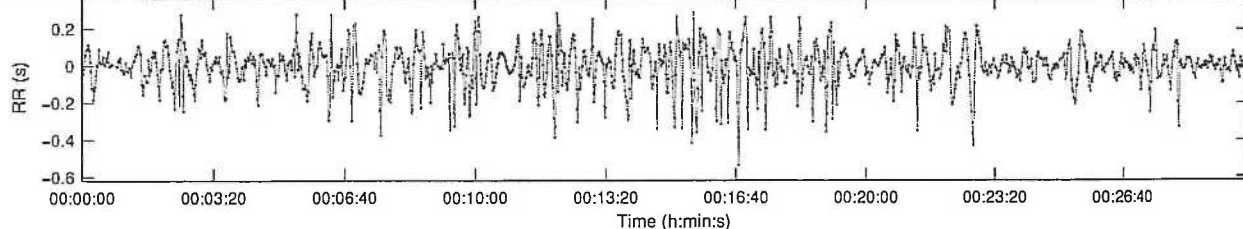
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RR Interval Time Series

Results for a single sample



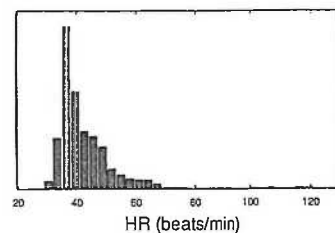
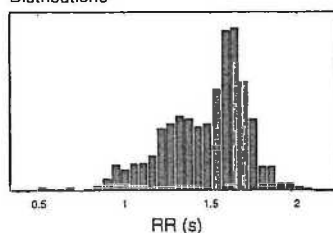
Selected Detrended RR Series



Time-Domain Results

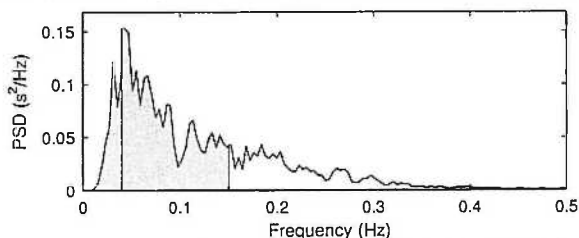
Variable	Units	Value
Mean RR*	(ms)	1471.8
STD RR (SDNN)	(ms)	113.9
Mean HR*	(1/min)	42.23
STD HR	(1/min)	6.94
RMSSD	(ms)	96.9
NN50	(count)	510
pNN50	(%)	38.8
RR triangular index		22.707
TINN	(ms)	620.0

Distributions*

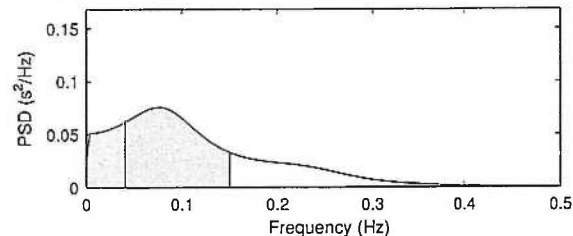


Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



AR Spectrum (AR model order = 16, not factorized)



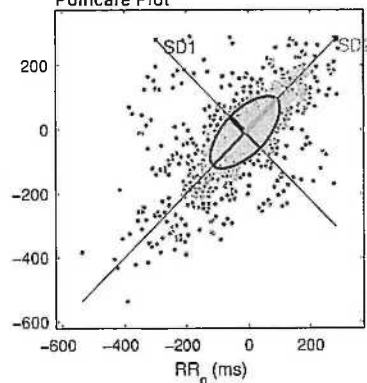
Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0313	1646	12.7	
LF (0.04-0.15 Hz)	0.0430	7626	58.9	67.5
HF (0.15-0.4 Hz)	0.1836	3661	28.3	32.4
Total		12937		
LF/HF		2.083		

Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	2132	17.7	
LF (0.04-0.15 Hz)	0.0742	6610	55.0	66.8
HF (0.15-0.4 Hz)	0.1523	3283	27.3	33.2
Total		12027		
LF/HF		2.014		

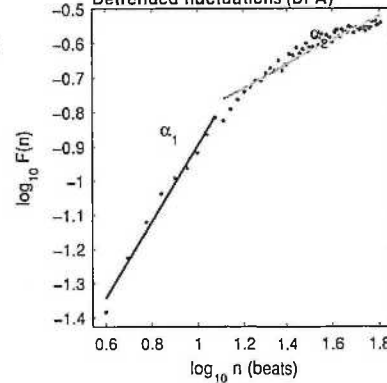
Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	68.5
SD2	(ms)	145.9
Recurrence plot		
Mean line length (Lmean)	(beats)	9.63
Max line length (Lmax)	(beats)	172
Recurrence rate (REC)	(%)	29.35
Determinism (DET)	(%)	98.62
Shannon Entropy (ShanEn)		3.079
Other		
Approximate entropy (ApEn)		1.225
Sample entropy (SampEn)		1.179
Detrended fluctuations (DFA): α1		1.117
Detrended fluctuations (DFA): α2		0.351
Correlation dimension (D2)		3.780
Multiscale entropy (MSE)		0.561 - 1.675

Poincare Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

HRV Analysis Results

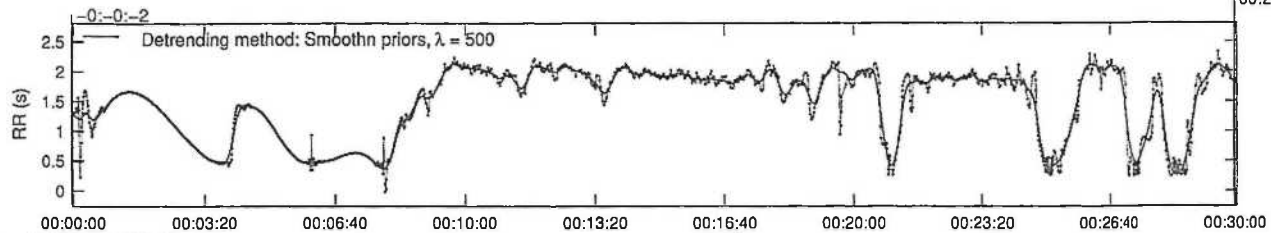
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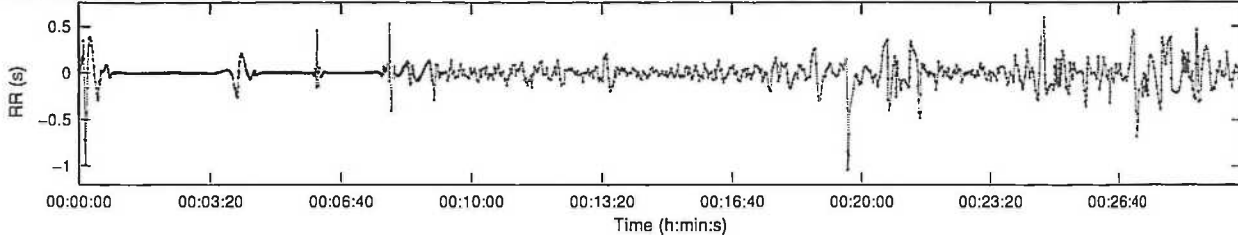
RR Interval Time Series

Results for a single sample

00:29:58



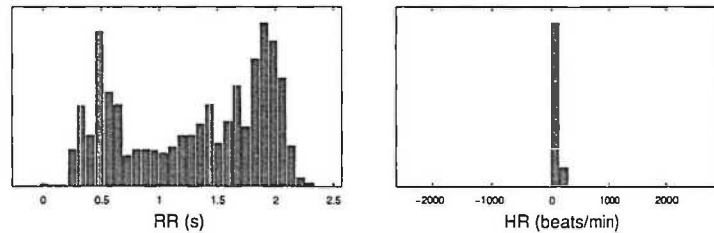
Selected Detrended RR Series



Time-Domain Results

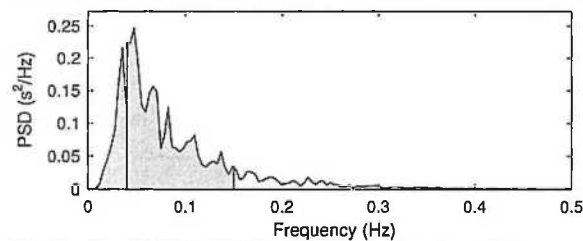
Variable	Units	Value
Mean RR*	(ms)	1295.1
STD RR (SDNN)	(ms)	139.0
Mean HR*	(1/min)	67.05
STD HR	(1/min)	91.23
RMSSD	(ms)	79.3
NN50	(count)	446
pNN50	(%)	31.1
RR triangular index		5.354
TINN	(ms)	1110.0

Distributions*



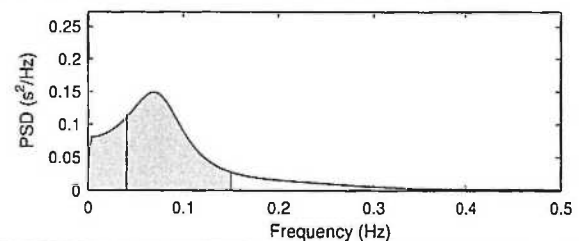
Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0352	2794	19.2	
LF (0.04-0.15 Hz)	0.0469	9860	67.8	84.0
HF (0.15-0.4 Hz)	0.1523	1881	12.9	16.0
Total		14539		
LF/HF		5.242		

AR Spectrum (AR model order = 16, not factorized)

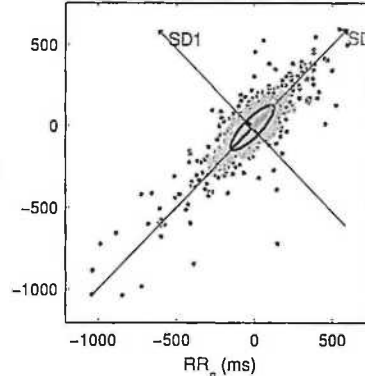


Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	3505	21.9	
LF (0.04-0.15 Hz)	0.0703	10248	63.9	81.8
HF (0.15-0.4 Hz)	0.1523	2278	14.2	18.2
Total		16035		
LF/HF		4.499		

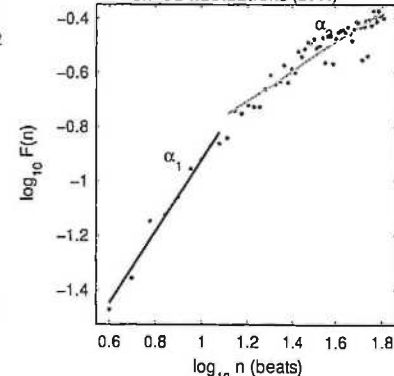
Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	56.1
SD2	(ms)	188.5
Recurrence plot		
Mean line length (Lmean)	(beats)	39.96
Max line length (Lmax)	(beats)	401.5
Recurrence rate (REC)	(%)	67.88
Determinism (DET)	(%)	99.87
Shannon Entropy (ShanEn)		4.352
Other		
Approximate entropy (ApEn)		0.732
Sample entropy (SampEn)		0.195
Detrended fluctuations (DFA): α1		1.314
Detrended fluctuations (DFA): α2		0.546
Correlation dimension (D2)		1.135
Multiscale entropy (MSE)		0.108 - 0.309

Poincare Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

HRV Analysis Results

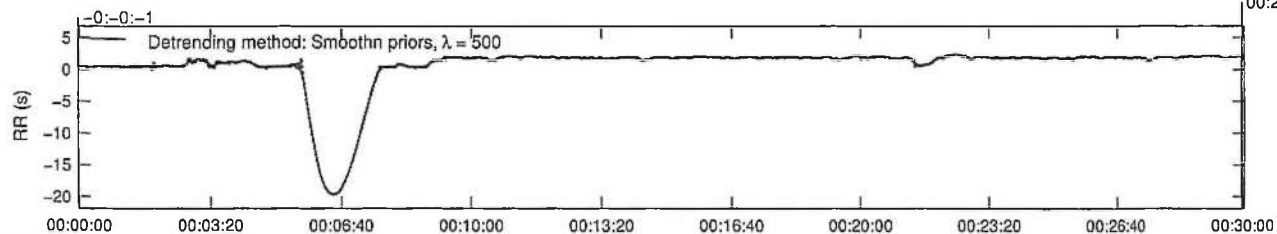
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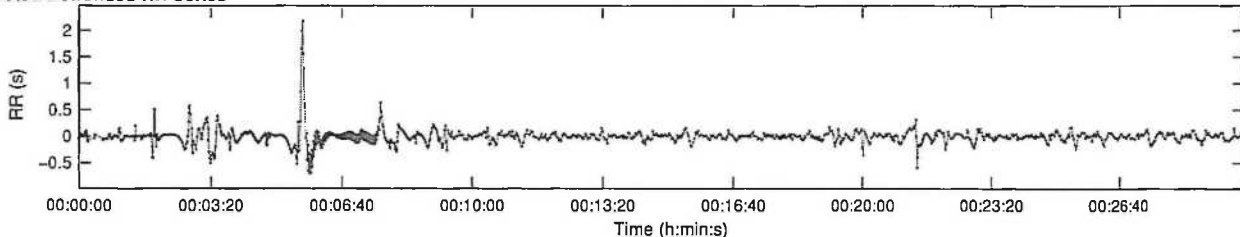
RR Interval Time Series

Results for a single sample

00:29:59



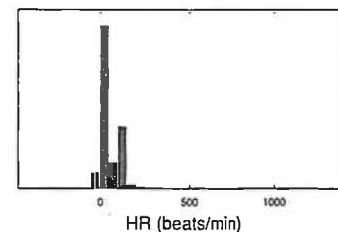
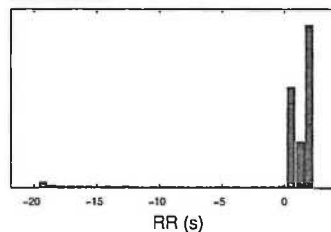
Selected Detrended RR Series



Time-Domain Results

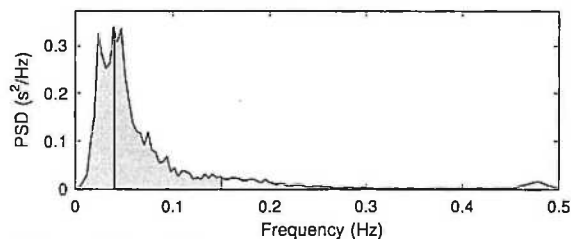
Variable	Units	Value
Mean RR*	(ms)	30.4
STD RR (SDNN)	(ms)	164.8
Mean HR*	(1/min)	57.68
STD HR	(1/min)	49.97
RMSSD	(ms)	100.5
NN50	(count)	453
pNN50	(%)	35.0
RR triangular index		16.405
TINN	(ms)	1475.0

Distributions*



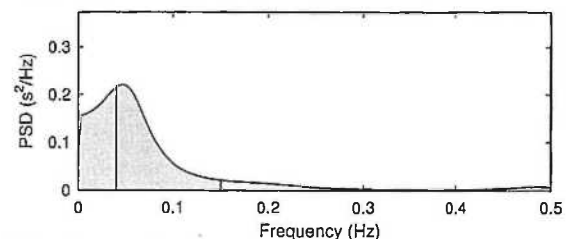
Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	6505	36.0	
LF (0.04-0.15 Hz)	0.0469	9747	54.0	84.4
HF (0.15-0.4 Hz)	0.1641	1795	9.9	15.5
Total		18052		
LF/HF		5.429		

AR Spectrum (AR model order = 16, not factorized)

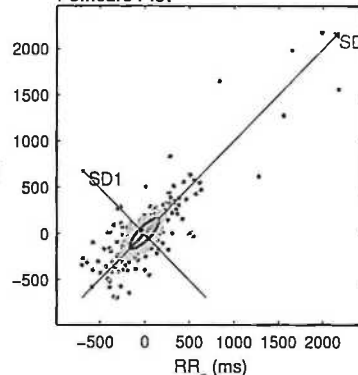


Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	6975	36.3	
LF (0.04-0.15 Hz)	0.0469	10508	54.7	86.0
HF (0.15-0.4 Hz)	0.1523	1710	8.9	14.0
Total		19197		
LF/HF		6.145		

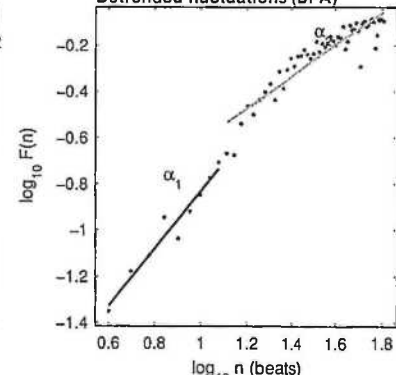
Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	71.1
SD2	(ms)	222.1
Recurrence plot		
Mean line length (Lmean)	(beats)	53.65
Max line length (Lmax)	(beats)	416
Recurrence rate (REC)	(%)	73.75
Determinism (DET)	(%)	99.91
Shannon Entropy (ShanEn)		4.575
Other		
Approximate entropy (ApEn)		0.834
Sample entropy (SampEn)		0.563
Detrended fluctuations (DFA): α1		1.241
Detrended fluctuations (DFA): α2		0.691
Correlation dimension (D2)		3.216
Multiscale entropy (MSE)		0.235 - 0.694

Poincare Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

HRV Analysis Results

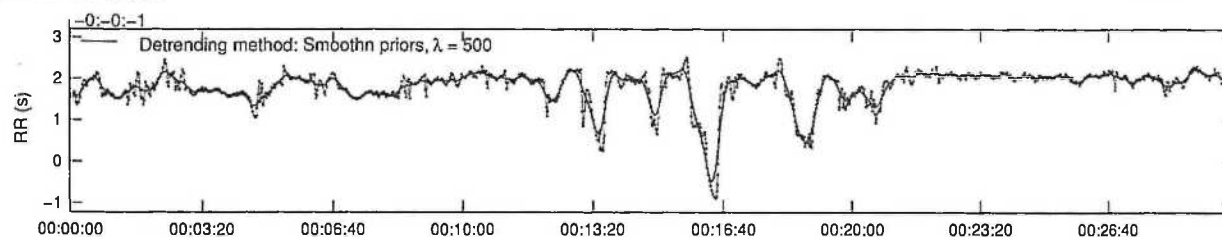
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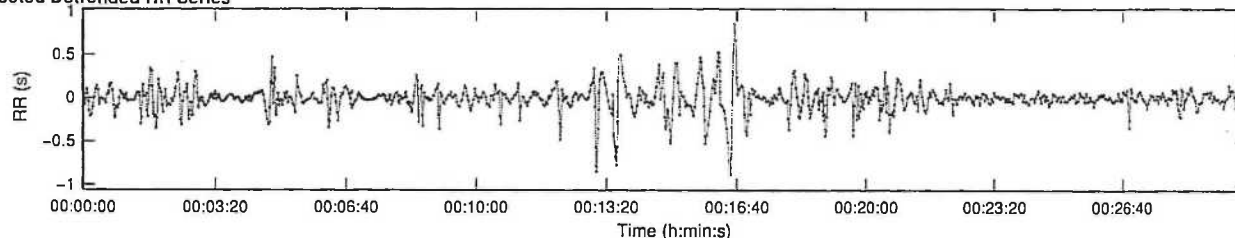
RR Interval Time Series

Results for a single sample

00:29:58



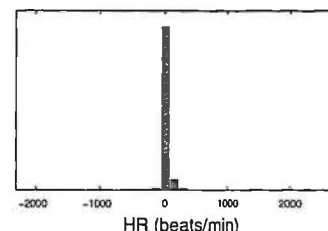
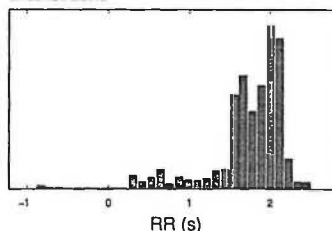
Selected Detrended RR Series



Time-Domain Results

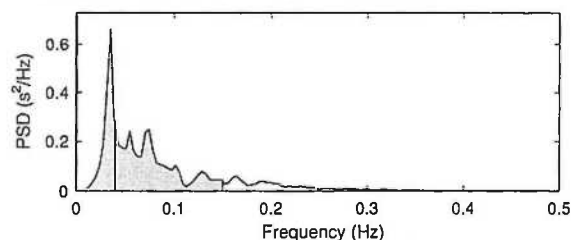
Variable	Units	Value
Mean RR*	(ms)	1713.6
STD RR (SDNN)	(ms)	170.2
Mean HR*	(1/min)	38.76
STD HR	(1/min)	92.35
RMSSD	(ms)	102.1
NN50	(count)	501
pNN50	(%)	42.6
RR triangular index		22.208
TINN	(ms)	1195.0

Distributions*



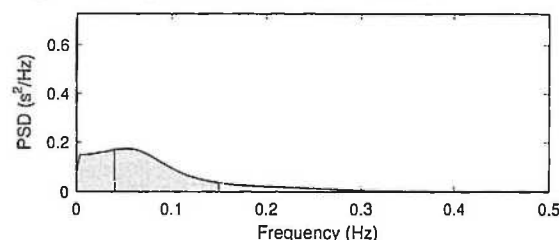
Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0352	6549	29.5	
LF (0.04-0.15 Hz)	0.0742	12171	54.8	77.7
HF (0.15-0.4 Hz)	0.1641	3501	15.8	22.3
Total		22223		
LF/HF		3.476		

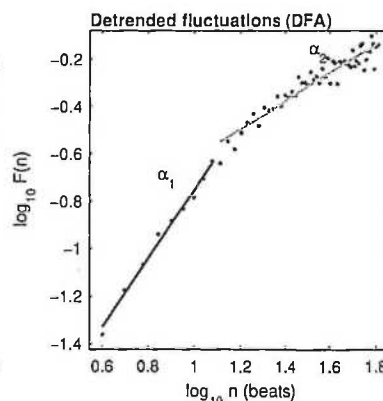
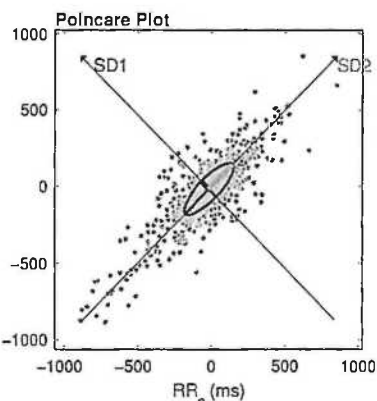
AR Spectrum (AR model order = 16, not factorized)



Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	6072	29.1	
LF (0.04-0.15 Hz)	0.0547	11891	57.0	80.3
HF (0.15-0.4 Hz)	0.1523	2908	13.9	19.6
Total		20874		
LF/HF		4.088		

Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	72.2
SD2	(ms)	229.4
Recurrence plot		
Mean line length (Lmean)	(beats)	20.90
Max line length (Lmax)	(beats)	150
Recurrence rate (REC)	(%)	52.40
Determinism (DET)	(%)	99.4
Shannon Entropy (ShanEn)		3.906
Other		
Approximate entropy (ApEn)		0.977
Sample entropy (SampEn)		0.706
Detrended fluctuations (DFA): α1		1.445
Detrended fluctuations (DFA): α2		0.599
Correlation dimension (D2)		3.032
Multiscale entropy (MSE)		0.316 - 0.919



*Results are calculated from the non-detrended selected RR series.

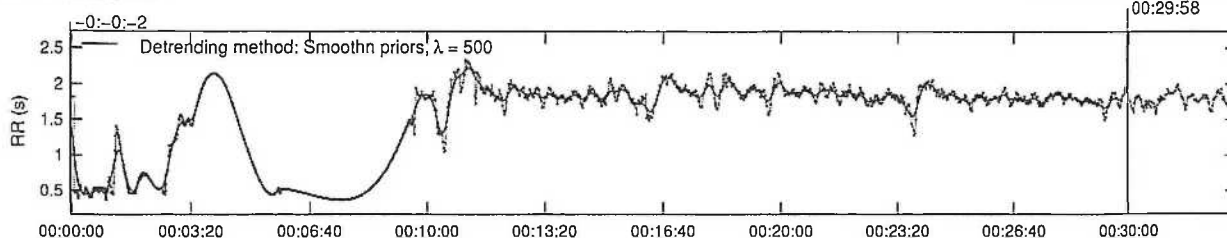
HRV Analysis Results

Rupert Slow Feeder Greedy Grid day 1.txt - xx/xx/xx - xx:xx:xx

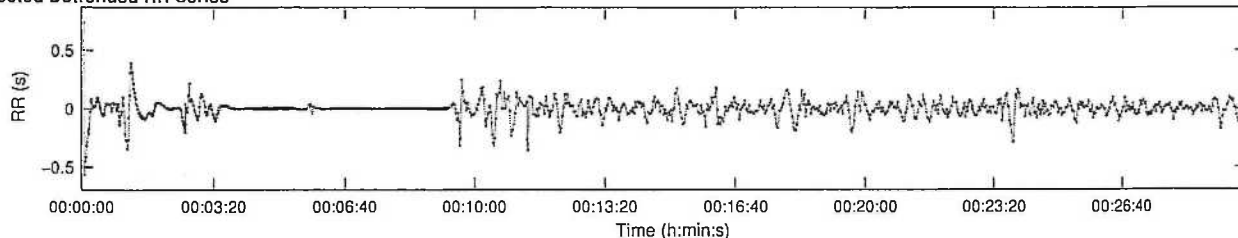
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RR Interval Time Series

Results for a single sample



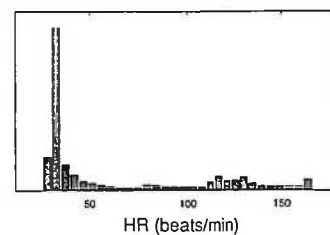
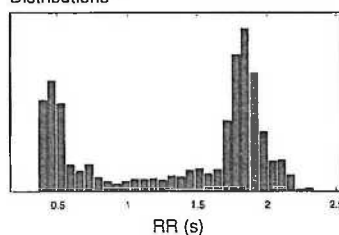
Selected Detrended RR Series



Time-Domain Results

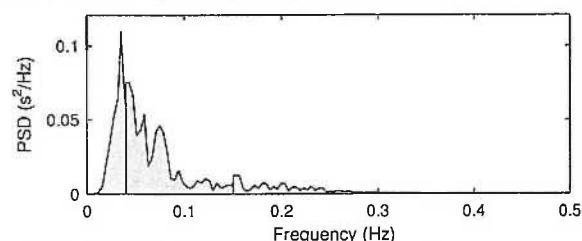
Variable	Units	Value
Mean RR*	(ms)	1354.8
STD RR (SDNN)	(ms)	77.3
Mean HR*	(1/min)	63.19
STD HR	(1/min)	10.82
RMSSD	(ms)	62.8
NN50	(count)	283
pNN50	(%)	21.7
RR triangular index		4.325
TINN	(ms)	875.0

Distributions*



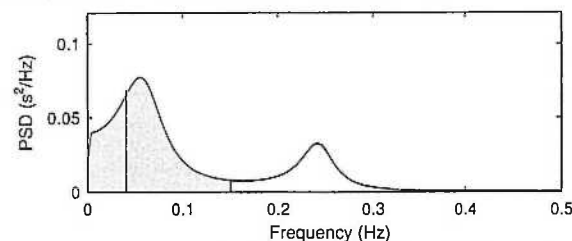
Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0352	1305	30.7	
LF (0.04-0.15 Hz)	0.0430	2414	56.8	82.0
HF (0.15-0.4 Hz)	0.1563	529	12.5	18.0
Total		4249		
LF/HF		4.560		

AR Spectrum (AR model order = 16, not factorized)

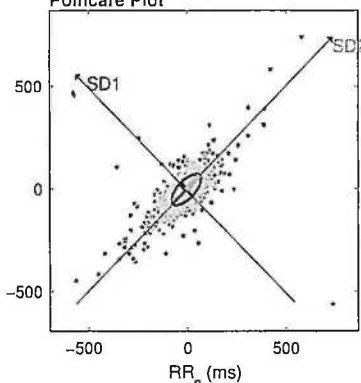


Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	1871	23.5	
LF (0.04-0.15 Hz)	0.0547	3896	48.9	63.9
HF (0.15-0.4 Hz)	0.2422	2201	27.6	36.1
Total		7970		
LF/HF		1.770		

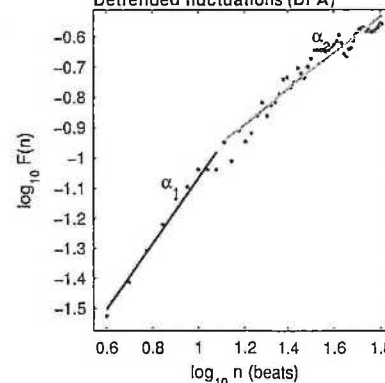
Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	44.4
SD2	(ms)	99.2
Recurrence plot		
Mean line length (Lmean)	(beats)	30.95
Max line length (Lmax)	(beats)	436
Recurrence rate (REC)	(%)	60.77
Determinism (DET)	(%)	99.39
Shannon Entropy (ShanEn)		3.944
Other		
Approximate entropy (ApEn)		0.777
Sample entropy (SampEn)		0.152
Detrended fluctuations (DFA): α1		1.093
Detrended fluctuations (DFA): α2		0.595
Correlation dimension (D2)		1.133
Multiscale entropy (MSE)		0.152 - 0.404

Poincare Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

HRV Analysis Results

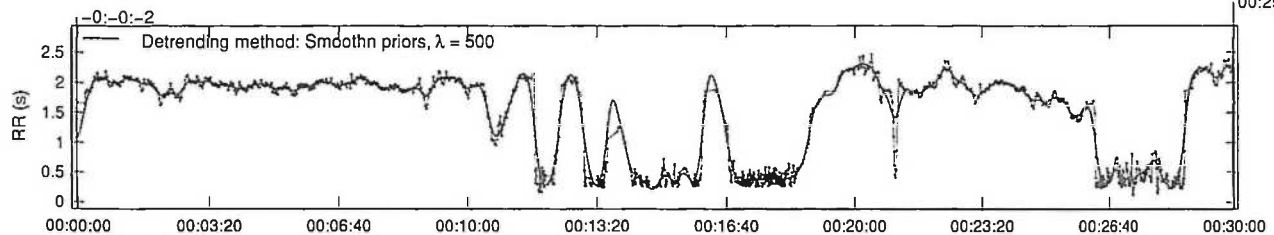
Rupert data 2 slow feeder greedy.txt - xx/xx/xx - xx:xx:xx

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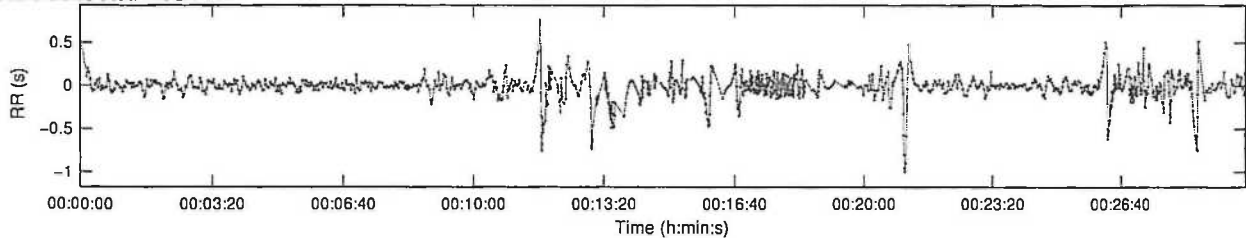
RR Interval Time Series

Results for a single sample

00:29:58



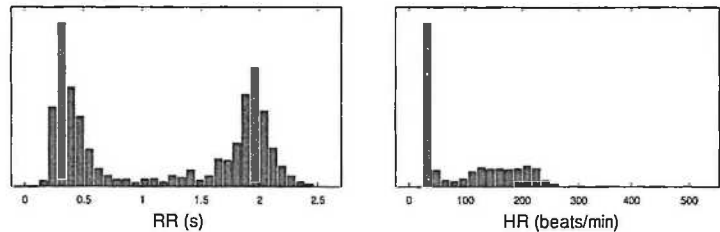
Selected Detrended RR Series



Time-Domain Results

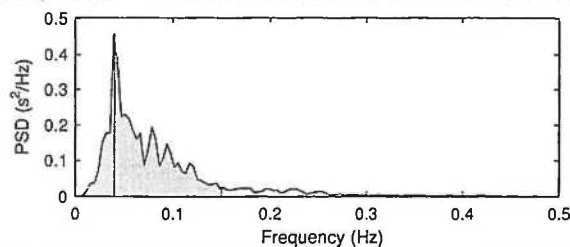
Variable	Units	Value
Mean RR*	(ms)	1151.1
STD RR (SDNN)	(ms)	162.3
Mean HR*	(1/min)	98.97
STD HR	(1/min)	43.59
RMSSD	(ms)	89.7
NN50	(count)	643
pNN50	(%)	46.4
RR triangular index		22.371
TINN	(ms)	1210.0

Distributions*



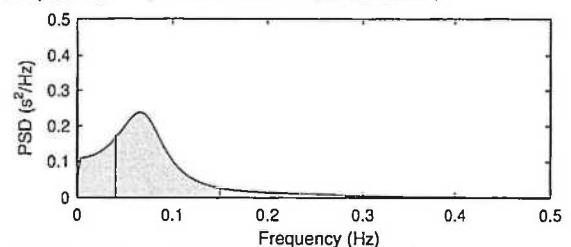
Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	3918	19.9	
LF (0.04-0.15 Hz)	0.0430	13558	68.9	86.0
HF (0.15-0.4 Hz)	0.1523	2211	11.2	14.0
Total		19691		
LF/HF		6.132		

AR Spectrum (AR model order = 16, not factorized)

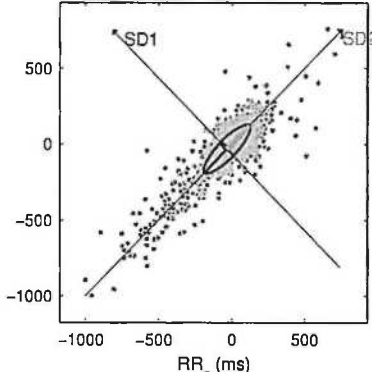


Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	4962	23.3	
LF (0.04-0.15 Hz)	0.0664	14129	66.4	86.6
HF (0.15-0.4 Hz)	0.1523	2181	10.3	13.4
Total		21275		
LF/HF		6.478		

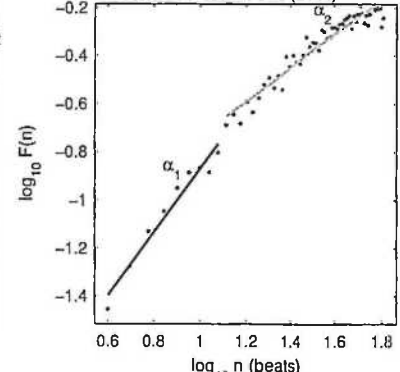
Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	63.5
SD2	(ms)	220.1
Recurrence plot		
Mean line length (Lmean)	(beats)	31.13
Max line length (Lmax)	(beats)	361
Recurrence rate (REC)	(%)	63.81
Determinism (DET)	(%)	99.73
Shannon Entropy (ShanEn)		4.177
Other		
Approximate entropy (ApEn)		1.158
Sample entropy (SampEn)		1.050
Detrended fluctuations (DFA): α1		1.319
Detrended fluctuations (DFA): α2		0.702
Correlation dimension (D2)		4.056
Multiscale entropy (MSE)		0.277 - 1.050

Poincare Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

HRV Analysis Results

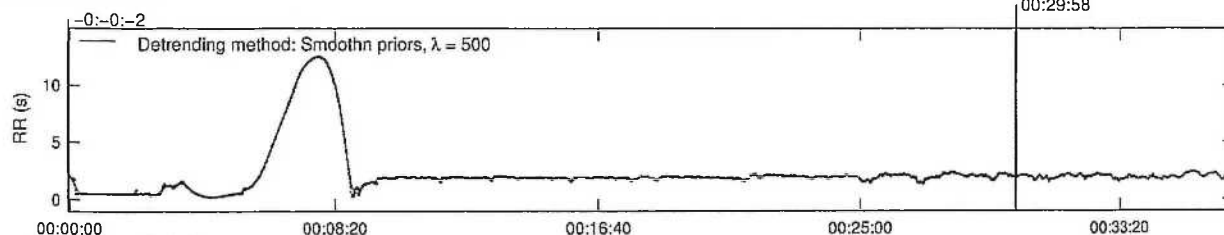
rupert slow feeder greedy 3.txt - xx/xx/xx - xx:xx:xx

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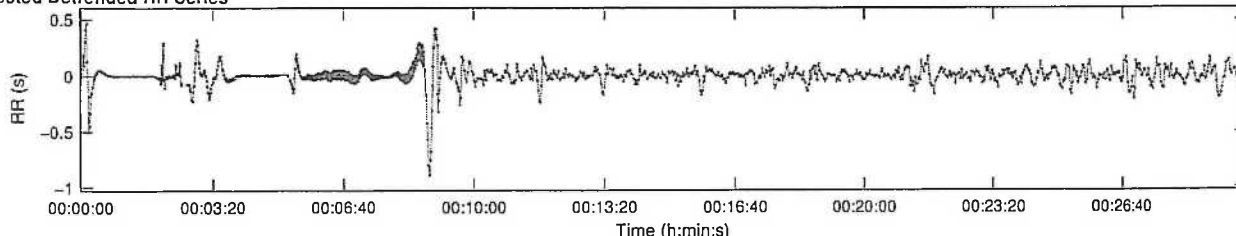
RR Interval Time Series

Results for a single sample

00:29:58



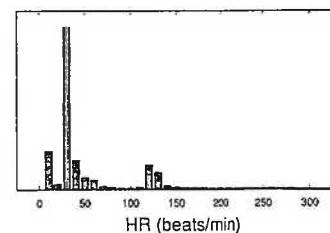
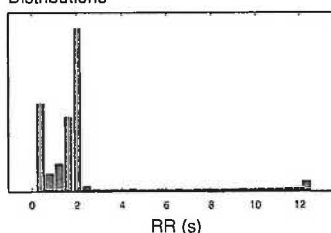
Selected Detrended RR Series



Time-Domain Results

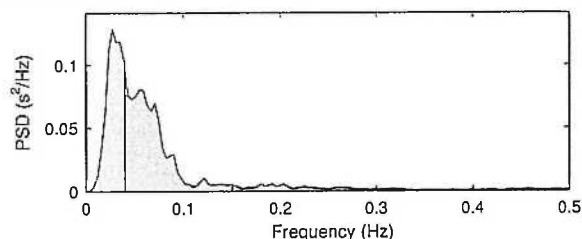
Variable	Units	Value
Mean RR*	(ms)	2395.7
STD RR (SDNN)	(ms)	96.9
Mean HR*	(1/min)	55.59
STD HR	(1/min)	20.64
RMSSD	(ms)	61.5
NN50	(count)	359
pNN50	(%)	29.3
RR triangular index		6.882
TINN	(ms)	915.0

Distributions*



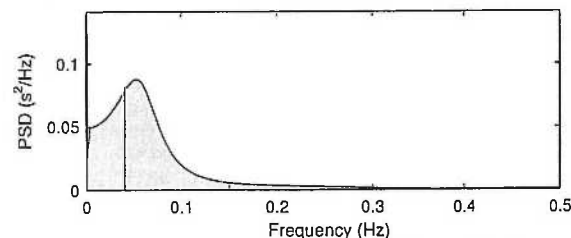
Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0273	2586	39.7	
LF (0.04-0.15 Hz)	0.0547	3454	53.0	87.9
HF (0.15-0.4 Hz)	0.2031	474	7.3	12.1
Total		6514		
LF/HF		7.291		

AR Spectrum (AR model order = 16, not factorized)

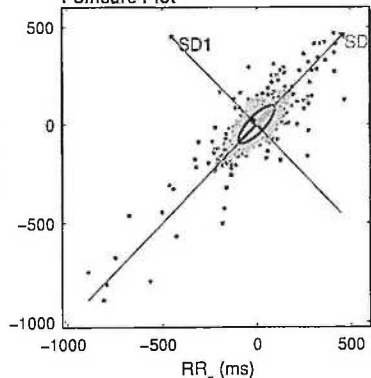


Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	2295	33.3	
LF (0.04-0.15 Hz)	0.0508	4063	58.9	88.3
HF (0.15-0.4 Hz)	0.1523	538	7.8	11.7
Total		6898		
LF/HF		7.556		

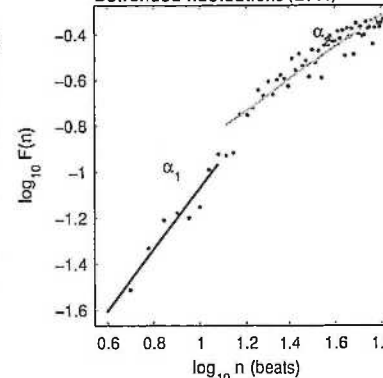
Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	43.5
SD2	(ms)	129.8
Recurrence plot		
Mean line length (Lmean)	(beats)	40.77
Max line length (Lmax)	(beats)	367
Recurrence rate (REC)	(%)	69.27
Determinism (DET)	(%)	99.90
Shannon Entropy (ShanEn)		4.415
Other		
Approximate entropy (ApEn)		0.884
Sample entropy (SampEn)		0.499
Detrended fluctuations (DFA): α1		1.335
Detrended fluctuations (DFA): α2		0.697
Correlation dimension (D2)		1.795
Multiscale entropy (MSE)		0.246 - 0.499

Poincare Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

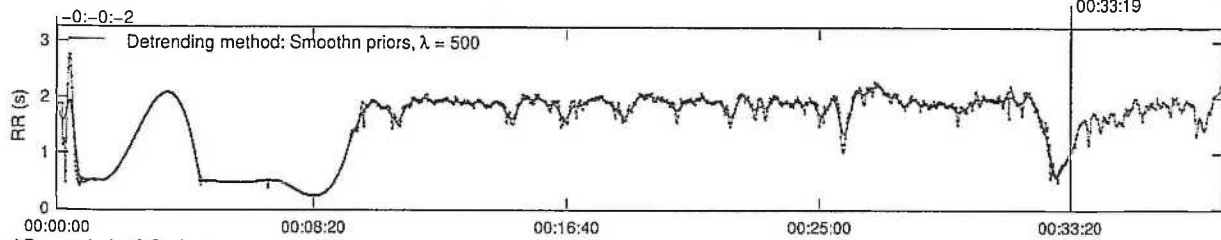
HRV Analysis Results

rupert slow feeder normal.txt - xx/xx/xx - xx:xx:xx

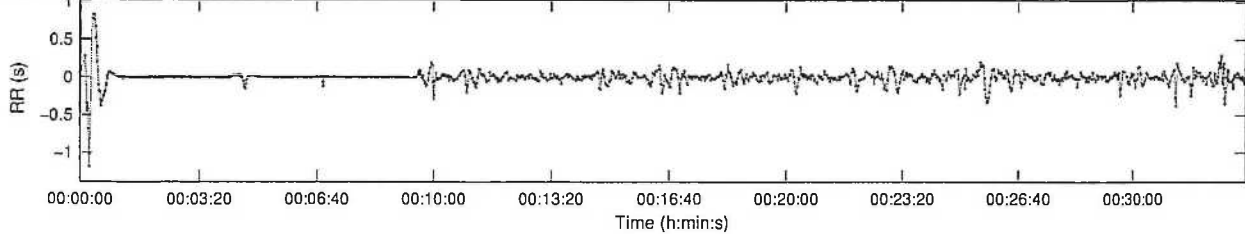
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RR Interval Time Series

Results for a single sample



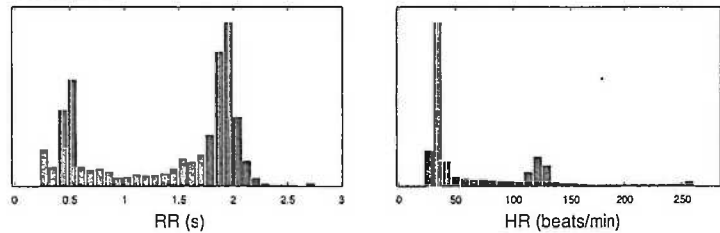
Selected Detrended RR Series



Time-Domain Results

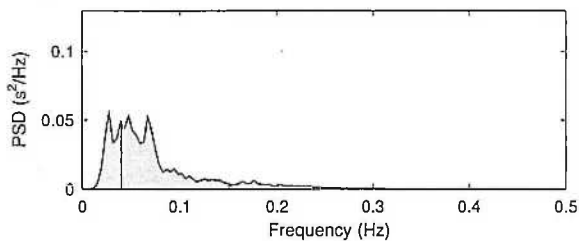
Variable	Units	Value
Mean RR*	(ms)	1378.7
STD RR (SDNN)	(ms)	102.7
Mean HR*	(1/min)	66.03
STD HR	(1/min)	11.48
RMSSD	(ms)	60.8
NN50	(count)	308
pNN50	(%)	21.7
RR triangular index		4.006
TINN	(ms)	1350.0

Distributions*



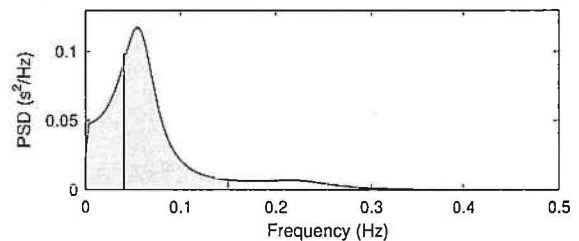
Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0273	871	25.9	
LF (0.04-0.15 Hz)	0.0469	2165	64.3	86.8
HF (0.15-0.4 Hz)	0.1758	329	9.8	13.2
Total		3365		
LF/HF		6.581		

AR Spectrum (AR model order = 16, not factorized)

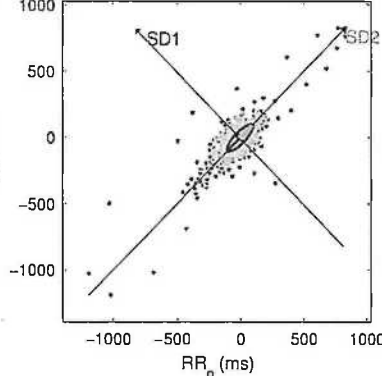


Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	2379	29.0	
LF (0.04-0.15 Hz)	0.0547	5050	61.5	86.5
HF (0.15-0.4 Hz)	0.1523	785	9.6	13.5
Total		8214		
LF/HF		6.431		

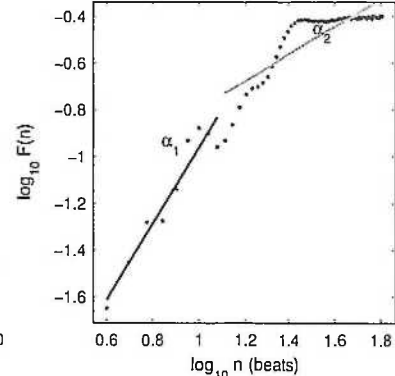
Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	43.0
SD2	(ms)	138.8
Recurrence plot		
Mean line length (Lmean)	(beats)	77.16
Max line length (Lmax)	(beats)	598
Recurrence rate (REC)	(%)	85.83
Determinism (DET)	(%)	99.89
Shannon Entropy (ShanEn)		4.562
Other		
Approximate entropy (ApEn)		0.566
Sample entropy (SampEn)		0.162
Detrended fluctuations (DFA): α1		1.634
Detrended fluctuations (DFA): α2		0.581
Correlation dimension (D2)		0.727
Multiscale entropy (MSE)		0.050 - 0.212

Poincare Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

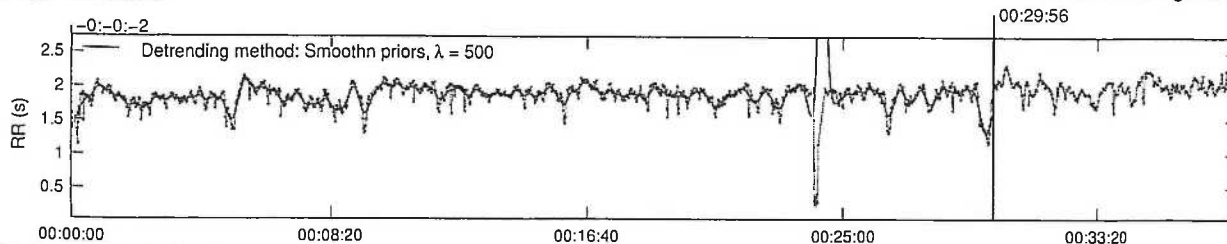
HRV Analysis Results

rupert sfn day 2.txt - xx/xx/xx - xx:xx:xx

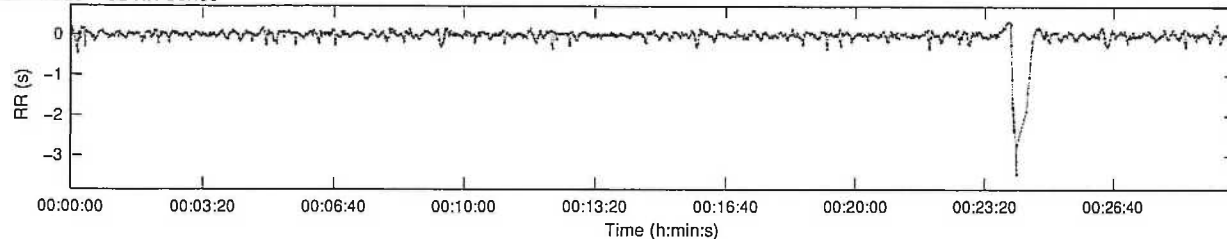
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RR Interval Time Series

Results for a single sample



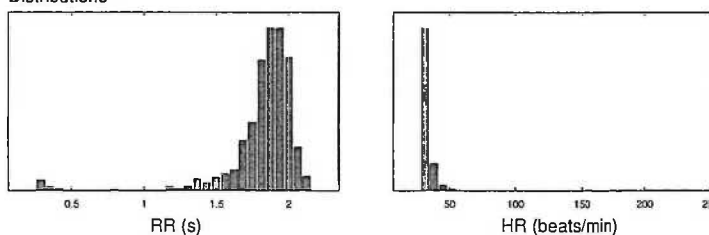
Selected Detrended RR Series



Time-Domain Results

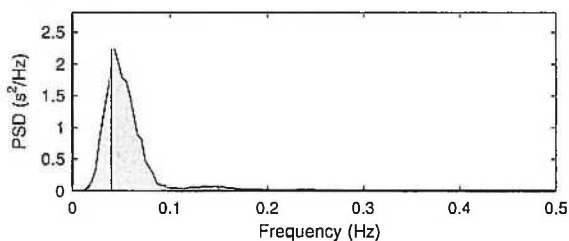
Variable	Units	Value
Mean RR*	(ms)	1822.6
STD RR (SDNN)	(ms)	336.4
Mean HR*	(1/min)	35.71
STD HR	(1/min)	18.63
RMSSD	(ms)	99.9
NN50	(count)	425
pNN50	(%)	42.8
RR triangular index		18.091
TINN	(ms)	1245.0

Distributions*



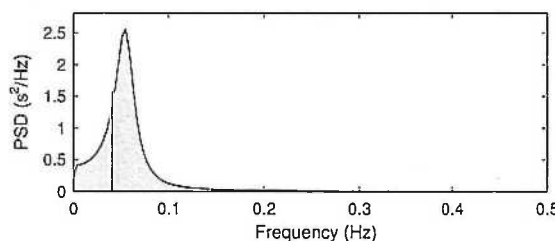
Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	21082	25.9	
LF (0.04-0.15 Hz)	0.0430	57619	70.9	95.7
HF (0.15-0.4 Hz)	0.1523	2592	3.2	4.3
Total		81293		
LF/HF		22.231		

AR Spectrum (AR model order = 16, not factorized)

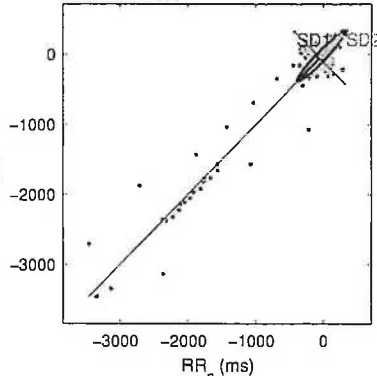


Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	24710	25.6	
LF (0.04-0.15 Hz)	0.0547	69043	71.6	96.2
HF (0.15-0.4 Hz)	0.1523	2730	2.8	3.8
Total		96484		
LF/HF		25.293		

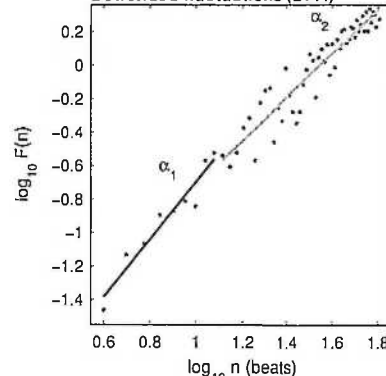
Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	70.7
SD2	(ms)	470.7
Recurrence plot		
Mean line length (Lmean)	(beats)	238.45
Max line length (Lmax)	(beats)	779
Recurrence rate (REC)	(%)	93.50
Determinism (DET)	(%)	100.00
Shannon Entropy (ShanEn)		5.073
Other		
Approximate entropy (ApEn)		0.616
Sample entropy (SampEn)		0.460
Detrended fluctuations (DFA): α_1		1.722
Detrended fluctuations (DFA): α_2		1.304
Correlation dimension (D2)		4.795
Multiscale entropy (MSE)		0.031 - 0.460

Poincare Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.

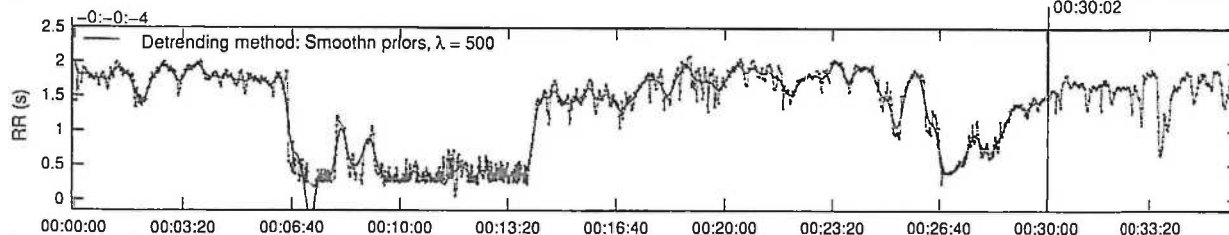
HRV Analysis Results

rupert sf normal day 3.txt - xx/xx/xx - xx:xx:xx

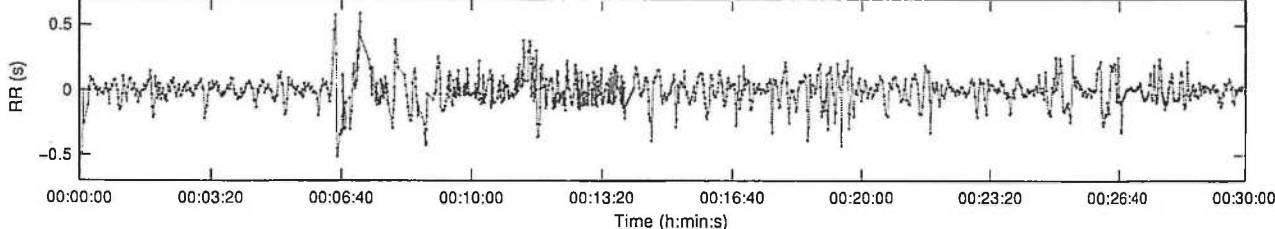
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RR Interval Time Series

Results for a single sample
00:30:02



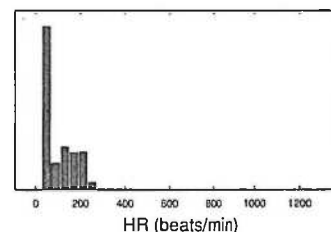
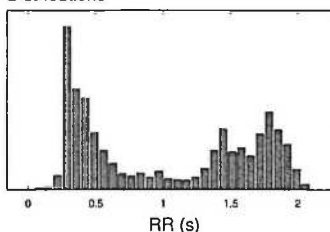
Selected Detrended RR Series



Time-Domain Results

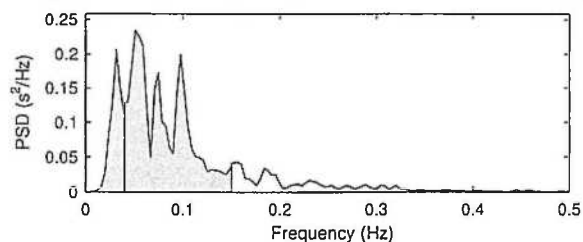
Variable	Units	Value
Mean RR*	(ms)	1019.6
STD RR (SDNN)	(ms)	114.1
Mean HR*	(1/min)	99.56
STD HR	(1/min)	44.60
RMSSD	(ms)	83.5
NN50	(count)	631
pNN50	(%)	38.9
RR triangular index		16.240
TINN	(ms)	820.0

Distributions*



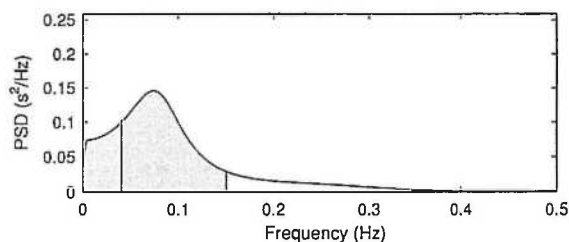
Frequency-Domain Results

FFT spectrum (Welch's periodogram: 256 s window with 50% overlap)



Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0313	2709	16.8	
LF (0.04-0.15 Hz)	0.0508	10989	68.2	82.0
HF (0.15-0.4 Hz)	0.1563	2407	14.9	18.0
Total		16108		
LF/HF		4.565		

AR Spectrum (AR model order = 16, not factorized)

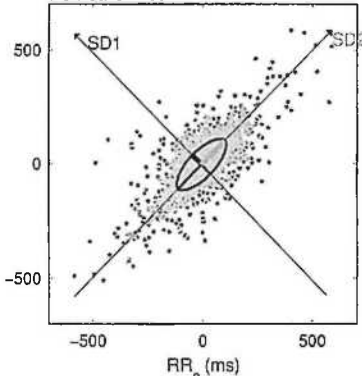


Frequency Band	Peak (Hz)	Power (ms²)	Power (%)	Power (n.u.)
VLF (0-0.04 Hz)	0.0391	3203	19.9	
LF (0.04-0.15 Hz)	0.0742	10402	64.8	80.9
HF (0.15-0.4 Hz)	0.1523	2449	15.3	19.1
Total		16057		
LF/HF		4.247		

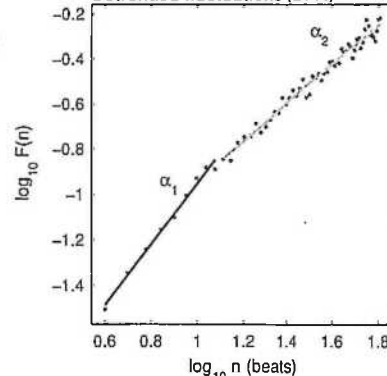
Nonlinear Results

Variable	Units	Value
Poincare plot		
SD1	(ms)	59.0
SD2	(ms)	149.6
Recurrence plot		
Mean line length (Lmean)	(beats)	18.17
Max line length (Lmax)	(beats)	330
Recurrence rate (REC)	(%)	50.10
Determinism (DET)	(%)	99.23
Shannon Entropy (ShanEn)		3.768
Other		
Approximate entropy (ApEn)		1.281
Sample entropy (SampEn)		1.210
Detrended fluctuations (DFA): α1		1.335
Detrended fluctuations (DFA): α2		0.860
Correlation dimension (D2)		4.176
Multiscale entropy (MSE)		0.638 - 1.350

Poincare Plot



Detrended fluctuations (DFA)



*Results are calculated from the non-detrended selected RR series.