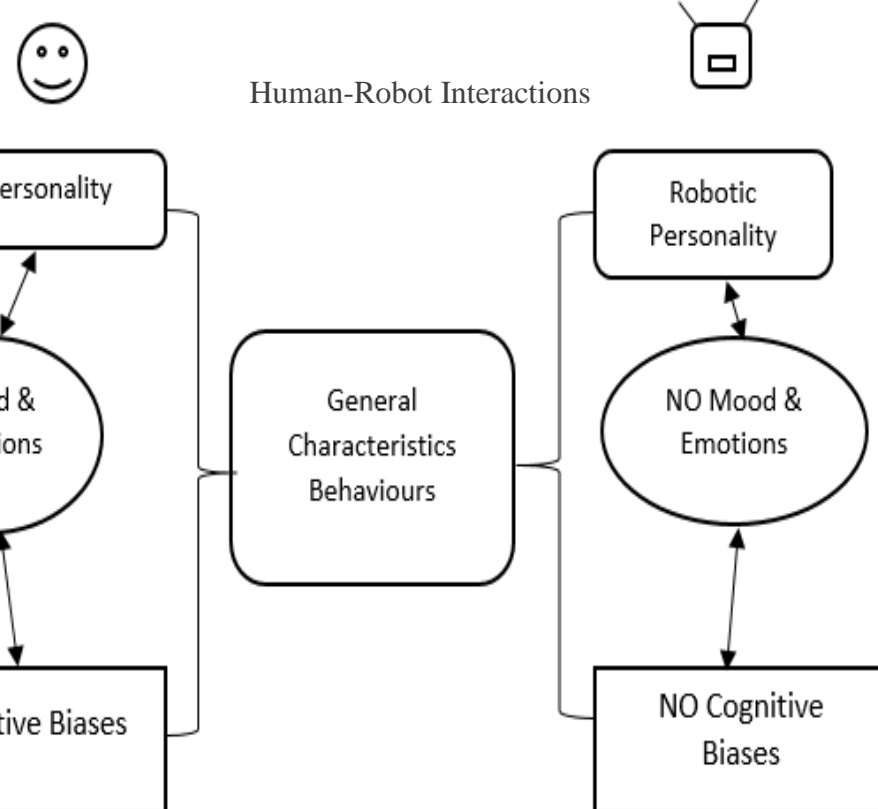
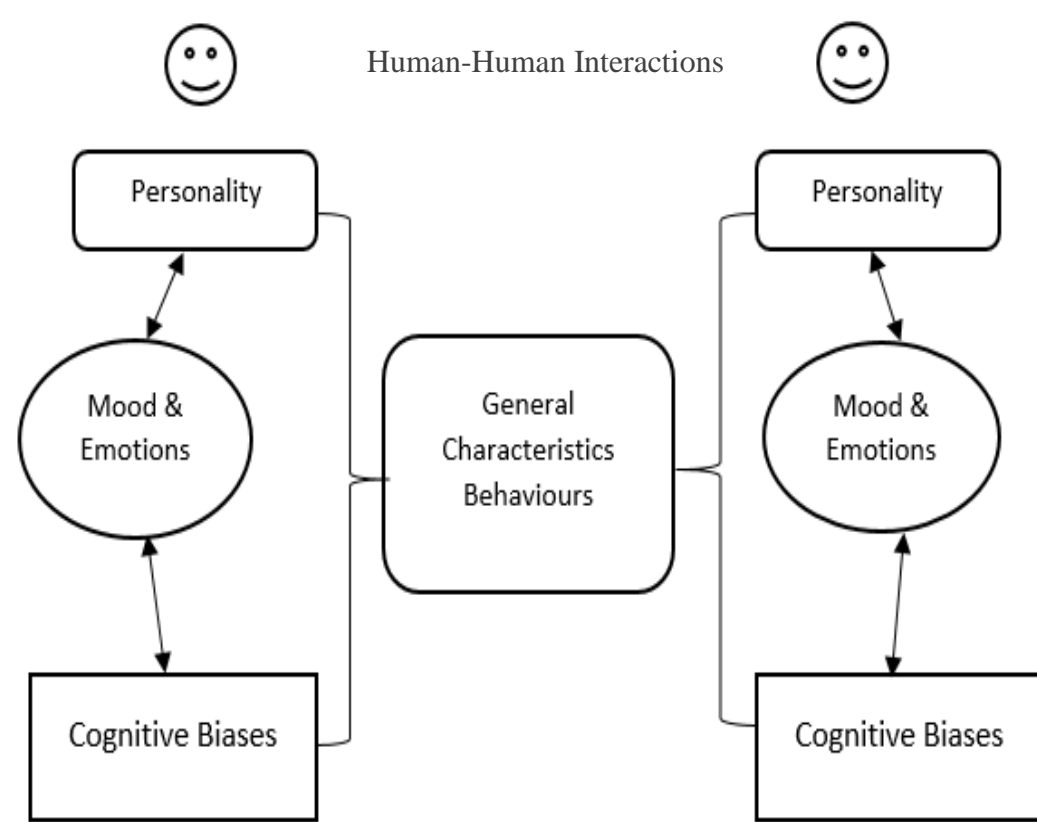


DIFFERENCE BETWEEN HUMAN'S INTERACTIONS AND HUMAN-ROBOT INTERACTIONS

Humans have different cognitive thoughts, own personality, traits, cognitive characteristics and certain anxiety which have large impact on their thoughts. Humans are not perfect, but cognitive characteristics make humans what they are, and when humans interact, their cognitive personality reflects on their characteristics behaviours. Humans like/ dislike each other depending on their cognitive characteristics and then relationship forms. But, in human-robot interactions, the robot usually lacks of human-like cognitive personality, mood & emotions and cognitive bias effect in its behavioural characteristics. The current research is solely inspired by human's cognitive characteristics and interaction processes, and it aims to develop above human-like factors in autonomous robotic system and test it with human users to study how that will affect the human-robot interactions and long-term relationships.



Human-Robot Interactions are based on the human's general personality characteristics, current level of mood & emotions and effective cognitive biases, but on the robot's side only common robotic friendly personality without the presence of mood & emotions, any biases and also without human like anxiety or other human-like characteristics.

A SIMPLE MODEL FOR COMPANION ROBOT WITH HUMAN-LIKE FACTORS

The proposed autonomous model for the companion robot is as follow:

$$PCB \sim (F(P) \phi(Y) \psi(Z). CB) RR$$

PCB → Robot's characteristics personality behaviours with bias effects.

F(P) → Selected personality dimensions.

Φ(Y) → Current state of mood and emotions.

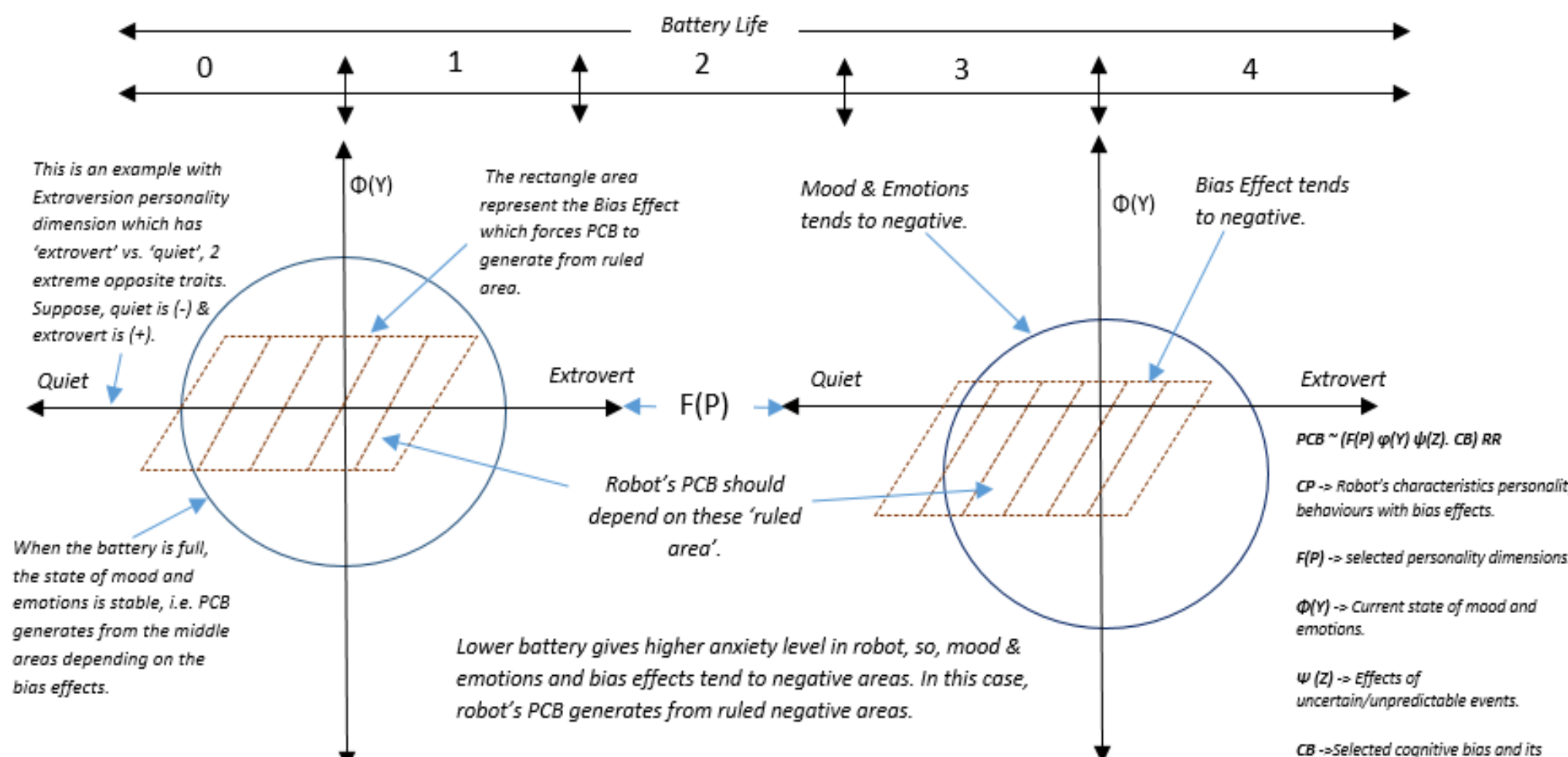
Ψ(Z) → User input.

CB → Cognitive bias and its effects.

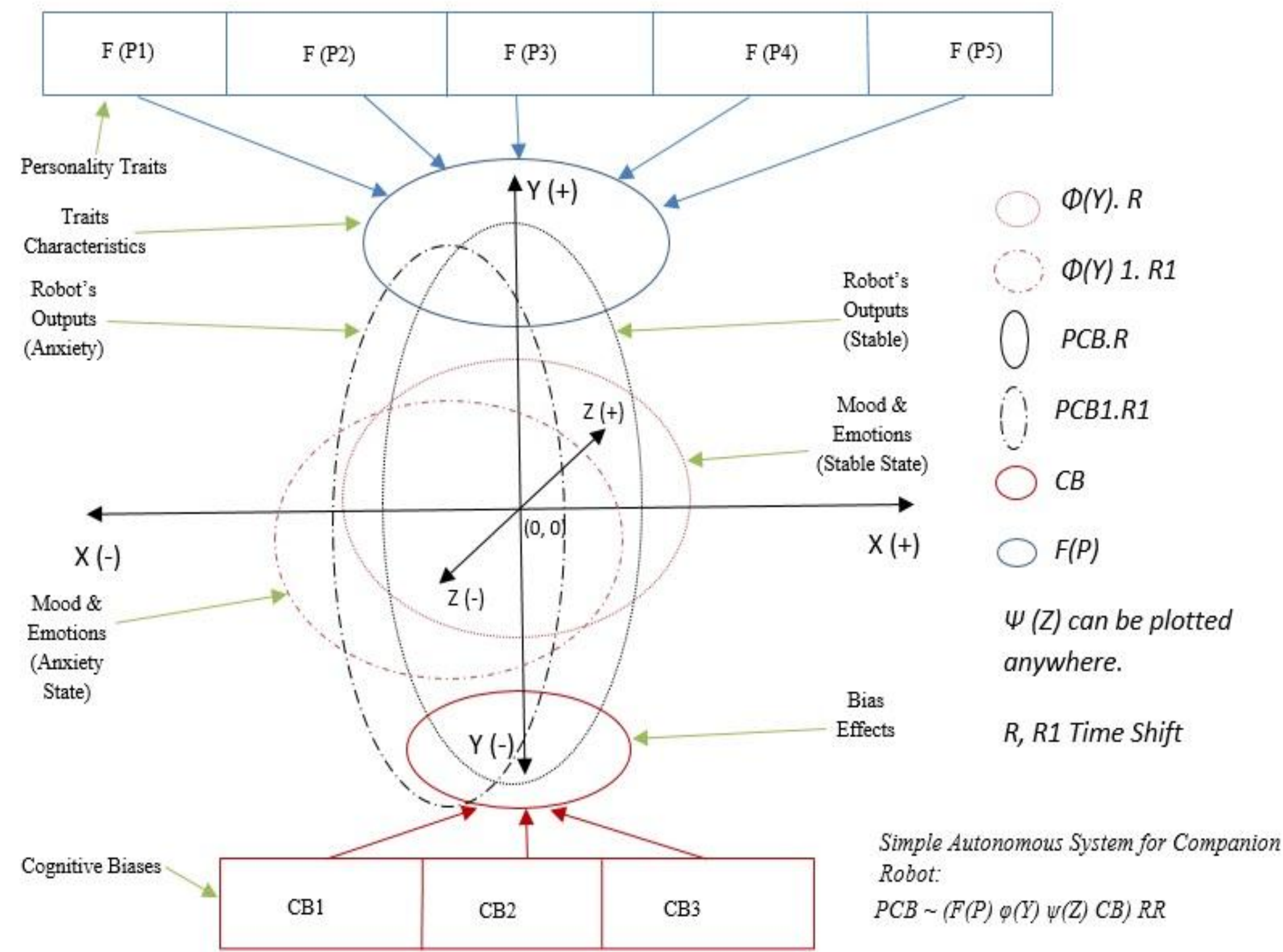
RR → Refresh rate of the battery.

Companion robot's general characteristics behaviours (**PCB**) to humans or its environments should be based on the input from the users (or the environment) (**Ψ(Z)**) to the robot's selected developed personality dimensions (**F(P)**) depending on the current state of mood and emotions (**Φ(Y)**) with the effect of selected cognitive bias (**CB**) and the current battery level (**RR**) of the robot.

In the proposed model, we are considering a specific personality trait dimension (**F(P)**), state of mood & emotions (**Φ(Y)**), cognitive bias effect (**CB**) and robot's anxiety (**RR**) which depends on the battery. All these factors can effect and determine the robot's responses to a certain input (**Ψ(Z)**) from the user. Robot's characteristics behaviours can follow certain rules but not limited to that, i.e. on the same situation same input from the different source can change the robot's output depending on the certain factors, like, battery level, state of mood & emotions and bias effects.



General explanation of the autonomous system for companion robot with personality characteristics behaviours, mood & emotions, cognitive bias and anxiety.



Simple Autonomous System for Companion Robot.
PCB ~ (F(P) φ(Y) ψ(Z) CB) RR

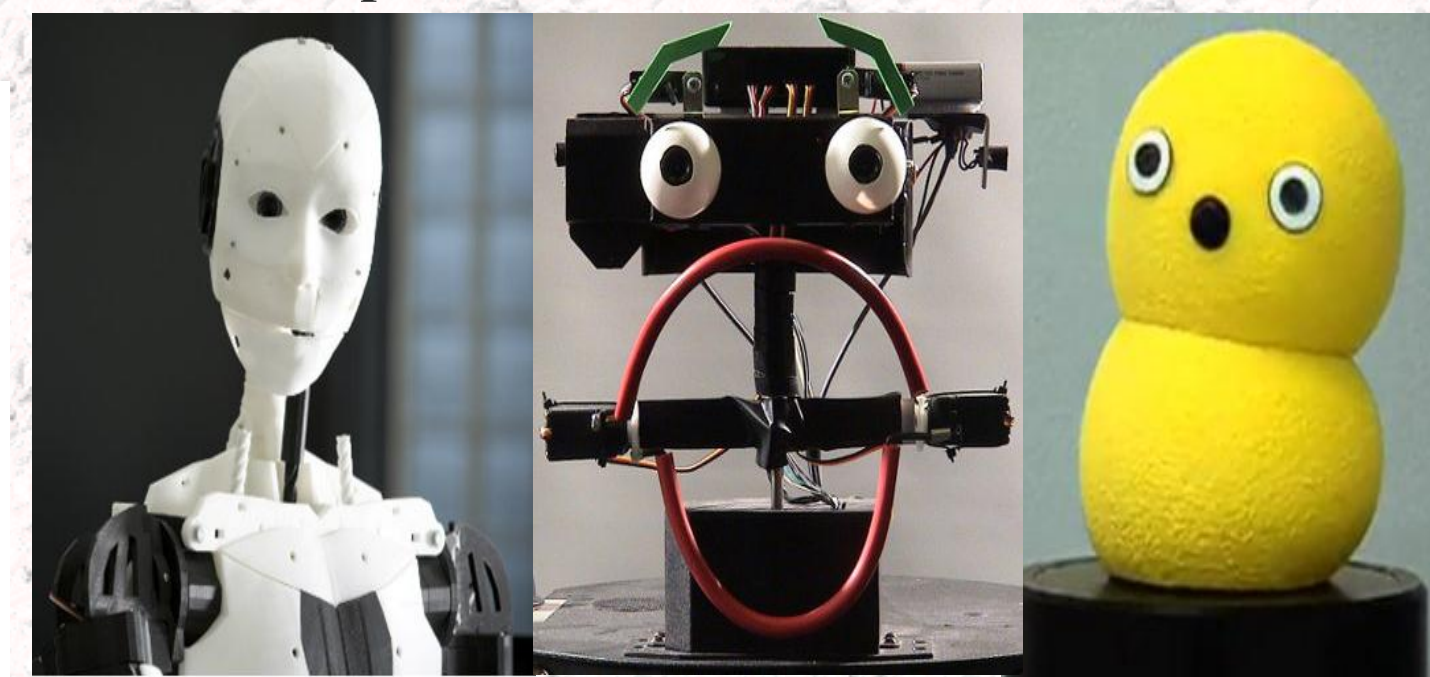
GENERAL RULES FOR THE PROPOSED MODEL

Selected personality dimension should have 2 extreme traits. Example: For the 'Extroversion' personality dimension 2 opposite traits are 'extrovert' vs. 'introvert'.

Depending on the battery level, the current state of 'mood & emotions' changes, i.e. if the battery is full then the mood & emotions is stable and PCB generates from middle area of the graph with bias effects.

Bias effects affect the PCB followed by the battery level and the current level of mood and emotions.

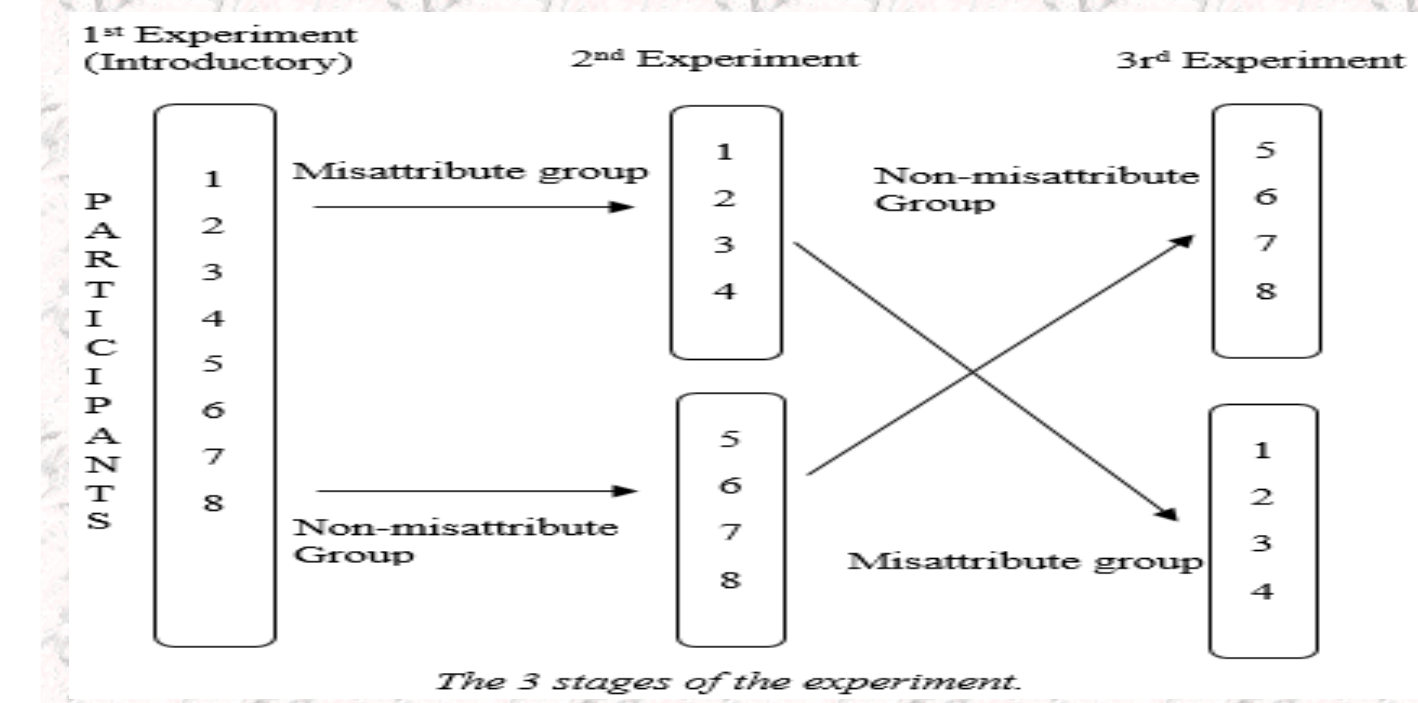
The battery level can control 'anxiety' in robot. Suppose the full battery gives robot 4 hours of life, then as the battery level goes down the robot's anxiety increases which affects on robot's selection of choices to the output.



MARC, ERWIN, KEEPON- these are the robots are being used to experiment the described autonomous model, also, the research aims to find out which robot and characteristics behaviours are more accepted by the participants, - a 3D robot with human-like body movements, ERWIN which can express 5 basic emotions, KEEPON which responds with dance moves to the participants reactions.

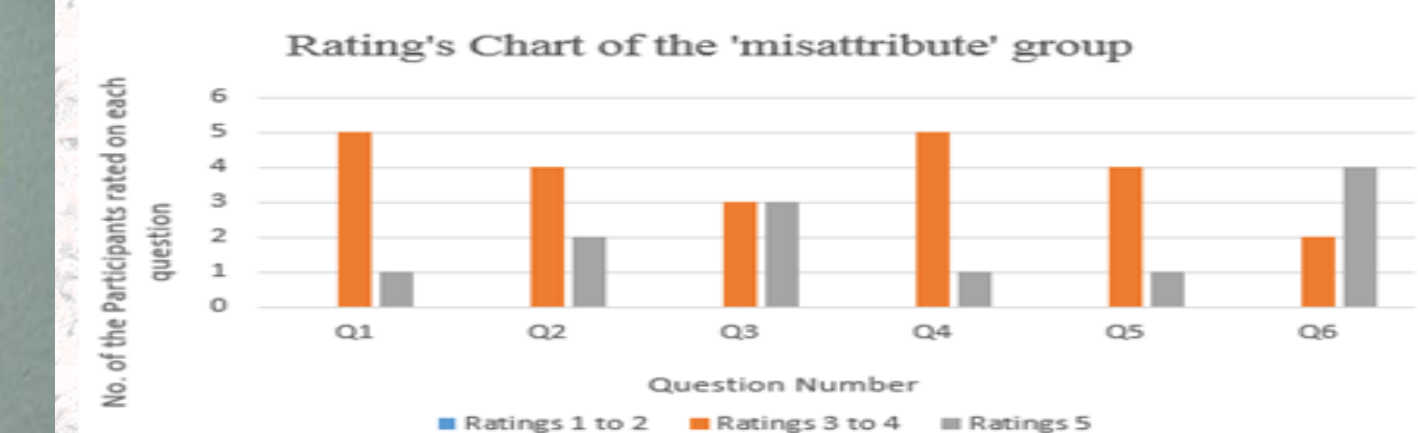
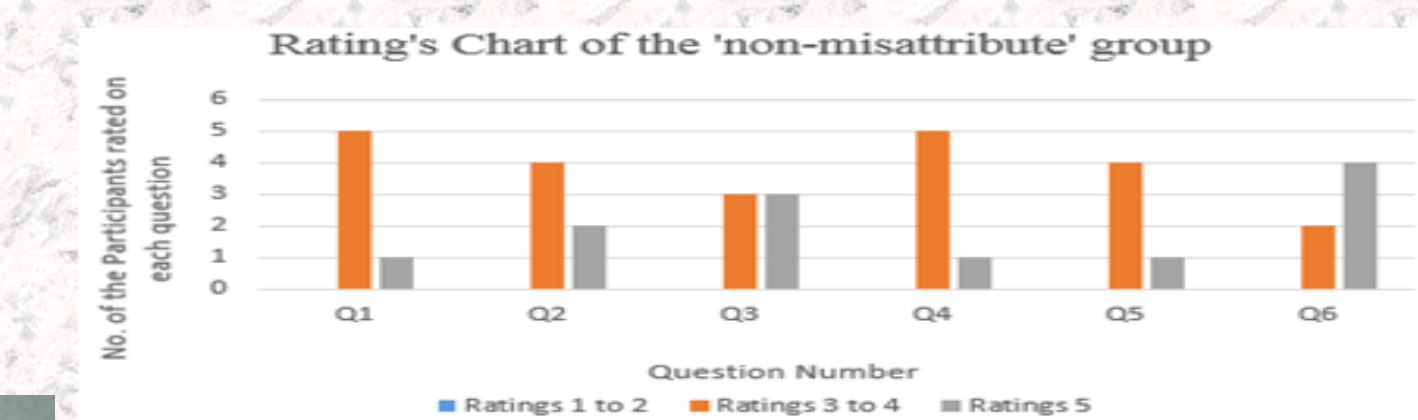
EXPERIMENTS & RESULTS

Previously an experiment has done to test the bias effects in the human-robot interactions with the robot ERWIN and with the 2 groups of the participants. The chosen bias was 'misattribution' which is human's common memory bias. For the first group of the participants, ERWIN misattribute some information from the previous interactions and for the other ERWIN remember everything correctly.



The 3 stages of the experiment.

Experiment data and results show that robot with general 'misattribute' bias is more likely to get human attention, therefore become more effective in human-robot interactions. From the experiment results, it can be said that robots should have human-like faults, characteristics biases and prone to carry out common mistakes that humans make on a regular social basis – which will develop the robot's own characteristics and should lead to the acceptance of a robot for long-term relationships with human.



It is expected that cognitive characteristics and personality in robots will make it easy for people to relate with. Described experimental results show that, participants enjoyed and developed preferred relationship faster with misattributed robot than the robot without the bias, also it shows how one simple cognitive memory bias 'misattribution' was able to develop better interaction with participants than the interactions without misattributions.