



Interconnection Between Human's Psychological Elements and Their Influential Mediums and Channels Are Potential Accelerators to Comprehend People's Inclination Towards Autonomous Vehicles

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# INTERCONNECTION BETWEEN HUMAN'S PSYCHOLOGICAL ELEMENTS AND THEIR INFLUENTIAL MEDIUMS AND CHANNELS ARE POTENTIAL ACCELERATORS TO COMPREHEND PEOPLE'S INCLINATION TOWARDS AUTONOMOUS VEHICLES

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## ABSTRACT

In technological evolution and scientific innovations, lots have been researched and studied to overcome the technical aspects and challenges. Much of the focus is on finding solutions in a technical area. It has been a continuous cycle of problems → solutions → upgrade → testing. However, it takes a prolonged time to reach near to perfection, which requires an abundance of resources like financial, R&D, time, and patience from companies, associated personals and when product is out, there is always questions of its acceptance, people's willingness (APW) to utilize them. APW terminologies are complicated, especially with the involvement of human aspects. The case of Autonomous vehicles (AVs) quite resembles well. However, the factors that trigger and influence these terminologies reside in the study of psychology. Both Psychology and Autonomous Vehicles (AVs) include extraordinarily complex terminologies, especially Psychology and their interconnections. In our paper, we decided to put an effort to understand those concepts at a granular level and presented our observed pattern, structure as well as theoretical Comparative Estimation table (CET) of terminologies through our understanding of literature reviews we studied. We believe our analysis and theoretical Comparative Estimation table based on selected psychological terminologies and channels or mediums through which people receive information, give some insights about people, psychological aspects and their decision making, and to understand people's willingness, acceptance about AVs. This paper will help companies tackle the challenges involving APW efficiently and develop solutions more productively and help researchers to develop better questionnaires for Surveys particularly people who are interested in targeting the side of human aspects of APW as far as psychology aspects, informative channel or mediums are concerned.

**Index Terms**— Psychology, Willingness, Acceptance, Human Aspects, Autonomous Vehicles

## 1. INTRODUCTION

Self-driving cars or so-called Autonomous vehicles offer a great deal of excitement and zeal to technological evolution. The concept itself is so full of excitement where self-driving vehicles can perceive the surrounded environment and navigation within a certain range without human intervention. To understand the concept and make a vision into reality, one must understand the involvement of multiple heterogeneous technologies and their collaboration, but proper functioning is critical. One paper (1) refers to autonomous cars as an integration of two industries fields: the automotive and mobile robot. Dealing with the inclusion of multiple and heterogeneous technologies also leads to multiple problems and challenges from various fields, not only technical but from non-technical fields too. Multiple companies, industries, manufacturers, and researchers from all over the world have been working for a long time to find the solutions for challenges and problems that occur on the way. According to a paper (2), Many of them are speeding past persisting technical challenges to AVs readiness. Nevertheless, one of the most important or, if not the most significant challenges, is adopting Autonomous vehicles (AVs), willingness to use the technology, and its acceptance. One of the most decisive factors that come to the surface is challenges related to not particularly technical but psychological aspects and medium or channel through which they affect the individuals, studied and explored by many but not extensively as it should be.

Psychology is an extraordinarily complex field. It has many variations and branches that are so overwhelming for an individual compared to technical fields. Thus, even though there has been astronomical research on psychology, it is tough to get binary answers that what we believe for the problems and challenges that exist within this field of research and similar experience we have observed in our study. Much research has been performed that discussed and correlates the psychological challenges and problems related to the acceptance, willingness to use, and AVs adoption. These (2), (3), (4), (5), (6), (7), (8), (9) are some of the re-

search we selected from a large pool of research knowledge that touches on Psychological aspects ranging from Morality, fear, people's desire and willingness, trust, responses, and reactions to anxiety, opinions, Ethical and Social Dilemma. When it comes to Psychology, emotions and decision making interconnected (10). So, Acceptance, willingness, and adoption are all also interconnected with psychological aspects and decision making (11) and (12). Even though these terminologies are expressed and touched by the researchers, the way these terminologies applied was vague. We observed not enough studies that explain these psychological terminologies in granular and their relationship with people's decision-making, leading to acceptance and willingness to use AVs. During our study, we also observed that some specific mediums or channels significantly influence psychological aspects (8), which we touch on in this paper.

In this paper, we try to understand the relationship between psychological aspects and decision-making and its relationship with acceptance, willingness to use, and adoption furthermore how they are connected at a very granular and simplistic level. As we study, we observed specific psychological terminologies that appear to be underpinning for other complicated psychological terminologies or so called compounded terminologies that continue being frequently used in research areas such as Social dilemmas, Ethical dilemmas, etc. Throughout our study of literature reviews and multiple online articles (published and independent) that we studied, we come across more than 20+ terminologies. However, for this paper, we have selected eight terminologies from different branches of psychology 1. Emotion Psychology 2. Social psychology 3. Cognitive Psychology and Biological psychology. We believe that these eight terminologies are fundamental to individuals' reaction, response, opinion and Perception or point of view [RROP] towards a particular thing or an object. They play a major role in individuals' decision-making towards a specific thing or an object responsible for how individuals show their willingness and acceptance towards certain things. Along with the above, we have also studied and touched on external mediums or channels as we call them; as these are the factors through which an individual grabs certain information and once information is received, it will go through psychological processing. In this paper, we limit ourselves as we divided them particularly into two main categories 1. Social 2. Mass Communication. Further on, we divide them into sub-categories such Peer Influence, Experience, Bandwagon Affect for Social and Mass Media, Alternate Media, and Social Media for Mass Communication. In closing, we combined our data and prepared a comparative table with little motivation from the references (13) and (14) we came across and content-organized maps which we believe could be beneficial for further studies.

## 2. LITERATURE REVIEW

According to article (15), psychology is referred to as the science of human behaviour that includes specific behaviour that applies to anything an individual does. There are multiple expressions in which humans behave, but two important and primary ways are covert and overt. Covert human behaviour is when a person or an individual expresses inside. In contrast to it is Overt behaviour which an individual expresses outside. For example, when individuals express themselves with symbolic adoption called covert behaviour and use acceptance as an example of overt behaviour expressions. Furthermore, the article divides human behaviour into three aspects Affection, Conation and Cognition, but the whole term used it as Act of behaviour. According to their branches for our study, we have certain divided psychological factors, and they have mentioned as Emotion Psychology, Social Psychology, Cognitive Psychology and Biological Psychology. Under these terminologies, we have further studied them at a granular level, which we presented in our paper to support our study.

### 2.1. Emotions

According to a article (15), emotions signify a state of being. It involves impulses. It also stirred up feelings, physical and as well as psychological reactions. Naturally, individuals can control their emotions, but it depends on a particular person's emotional capability. Every individual is different in dealing with emotions. Emotions involve impulses that could be either control or sudden based on how much they can control their emotions. People usually make logical decisions, but if emotions are unstable or the intensity of emotions is high, people make decisions sometimes based on emotions and that we can not deny. We believe emotions categories into two-part positive emotions and negative emotions. A negative response may commence nonparticipation and non-interest and non-cooperation if an individual has negative emotion about it. On the contrary, positive emotions may have opposite reactions than adverse reactions. Positive emotions may inject a sense of hope or positive thoughts into individual minds if their feelings express positive sensations. A paper (16) suggested some rules for emotional control. For example, avoid emotion-provoking situations, Change the emotion-provoking situation to control emotions. Nevertheless, even though individuals can control their emotions, it takes a lot of discipline and emotional control to do it. It is not easy for every individual to control them as promptly as it seems.

#### 2.1.1. Fear

Fear is an emotion. Many studies on crises fail to point out fear or anxiety at all. These (17), (18), (19), (20), other studies

talked about these terms quite briefly without much clarification (21), (22), (23). Some of the studies used the terminology Fear and related it interchangeably. As an example, a reference (24) do no distinction between anxiety, risk, safety, and Fear (25). Some studies use the terminology as integral to the characteristic of Fear (26). Fear is a topic that is distinctly underdeveloped in general (27). The study has shown that common people know plenty about emotions. Fear is a primal emotion communicated by all living creatures (27), and it has adaptive value, and that is the reason which allows us to avoid dangerous situations (28). Fear also considers a defensive response to avoid current threats (29) and (16).

Following are some of the detailed definitions presented for the term fear, which showed fear is an aversive emotional state which motivates people to avoid a particular and imminent threat (30), (31), (32), and (33) talks about three fundamentals of fears: Fear of injury, fear of anxiety, and Fear of negative evaluations. A paper (28) divide fear into various types; one example is fear of vehicles. One research has shown that people recognize fear when they see it or experience it (34). One paper (35) relates increase of fear as an entity directly proportional to the observation individual does by observing others' reactions and experience (e.g. (36), (37), (38)).

Other studies represented that fear triggers peoples' disengagement and emotion-seeking coping (self or social support) to escape and protect themselves (39). They mentioned fear as a basic emotion that motivates people to void a potential threat (29). Some studies also confirmed that fear could impact an individual's attitude and protective behaviours-toward the threat (29), (40), (41). Fear can also lead people to realize the severity of the threat, increasing their self-protection motivation (42), (43). In our paper, we have also categorized five parameters under the Fear category as explained in the paper (34).

### 2.1.2. Worry

Worry, though a paper (34) observes it as more a cognitive act than an emotional one but recognizing that both are difficult to separate. Worry identify as the individual's attempt to engage in mental problem-solving regarding tourist trip-related issues where outcomes are thought to be uncertain and contain possibilities for unfavourable results (44). The authors also distinguish worry from risk perception. While some tourists judge a destination as risky, they may not worry about it. By contrast, others may judge the same destination as not risky but may still worry about it. Worry, nervousness, and apprehension are often treated as synonymous with anxiety (45). Because of this reason, we have considered term Worry as a emotion and separated the term Worry from Risk. As explained in this paragraph, definitions represented two terminologies that are miles apart if we use them properly.

### 2.1.3. Anxiety

We Keep anxiety separate is because the term usually utilizes in comparison with worry, but as we could view in our previous paragraph about worry, anxiety is slightly different from worry. Other terminologies associated with anxiety are nervousness, which is also part of fear, but here we have selected anxiety, mainly because, the anxiety we can not avoid (46). One paper (47) writes that the individuals' operators themselves are often anxious over safety and property issues. Since our paper inclines towards acceptance and willingness of AVs, so anxiety makes more sense because it closely relates to safety issues, which is essential in AVs issues.

### 2.1.4. Risk

Risk and perception of risk apply to many aspects. One paper (26) mentioned risk as a proxy for fear, so it just elaborates the link between fear and risk. Other paper (48) divided risk into seven categories. It holds Equipment risk (breakdown), financial risk (value for money), physical risk (injury or sickness), psychological risk (vacation does not reflect the tourist's self-image or personality), satisfaction risk (vacation is not personally satisfying), and social risk (vacation will affect others' opinion of tourist). One paper (49) mentioned risk perception influences hesitation, which further influences the decision making, but knowledge can be crucial to moderation that relationship. As our paper focuses on the AVs' point of view, we highlight physical, psychological, equipment, but chiefly satisfaction and hesitation as primary focus because we believe these terminologies are closely related to AVs' risk.

### 2.1.5. Trust

Several definitions of trust between humans and machines have been proposed in many psychological studies but what we include in our paper is the definition we believe close to our objectives. A couple of them are as follows. According to the paper (50), "the confidence that one will find what is desired from another, rather than what is feared," and (51) and (52) represents trust as "the degree of confidence you feel when you think about a relationship." However, trust is a multidimensional construct. The author suggests that machine responsibility will become more critical in human-machine relationships to the extent that we choose to delegate autonomy and authority to "intelligent," but prosthetic, machines. The more power they are given, the greater the need for them to effectively communicate the intent of their actions so that the people who use them can have an appropriate expectation of their responsibility and interact with them effectively. The author presented trust as an expectation based on expectation basis at different levels of experience, including predictability, dependability or reliability, and faith. The growth of trust

will depend on the human's ability to estimate the machine's behaviours' predictability. Finally, since the human's trust is based upon observations of machine behaviour, behaviours must be observable for trust to grow. If a machine or function is distrusted, the user will, if possible, prefers to do the task or tasks by himself, which leave little or no opportunity for him to reevaluate his distrust because the machine (or function) has been removed from the system and is not delivering the behavioural evidence needed to hold a re-evaluation.

### 2.1.6. Anticipation

One paper (53) reasoned that there are eight raw emotions: anger, fear, sadness, disgust, surprise, anticipation, trust, and joy. According to a article (15), wishes are patterns. Patterns involve anticipated future satisfaction. Typically wishes are goal oriented. It directs towards the achievement of goals in future. We believe that future anticipation may play a significant role in a person's behaviour pattern or decision to act. People's actions may be higher based on considering the future anticipation of things, which leads to achievement. Same article (15) suggests that future anticipation is based on a subjective judgment, which might be irrational and faulty. We believe that future anticipation could be one of the significant factors in people's behaviour and decision-making. According to the article (54), Anticipation is a complex emotion that involves pleasure and anxiety while thinking or waiting for an anticipated event. Anticipation view in two completely different ways. Most evidently, the direction in which anticipation moves is dependent on what we expect to happen in the near future. It involves hope when pleasant things are expected and anxiety when negative ones otherwise. Anticipation is an emotion that can prepare us for the future. It allows us to plan and coordinate aspects of our lives based on what we expect.

Even though there is no prominent jury on how we perceive anticipation, the manifestations of anticipation are best explained by the feeling we may have experienced before getting on to a stage to give a presentation or talk. Science shows that most people anticipate positive events in the future much more than negative things. While this may feel contrary to popular belief, the fact is that people enjoy their positive predictions and do not feel the need to share those with others. On the other hand, negative predictions have them on edge, and most people share those to seek comfort, which affects the people talking to about adverse incidences more, and it helps to spread negative instances or new ones faster than the positive ones. Past experiences shape future expectations. Those with unpleasant past experiences are expected to have a higher level of negative anticipation episodes than others. Negative anticipation, however, can be crippling. It multiplies feeling the pain, worry, fear, and anxiety unnecessarily. On the other hand, positive anticipation does not need to be managed since it is a positive emotion. According to the authors, understanding of anticipation as an intrinsic

property of the mental reflection process includes the effects of temporary and spatial anticipation of events and the selectivity of environmental impacts, activity orientation, and behaviour (55). The writer suggests anticipation should be considered a specific cognitive-regulatory process, the basis of which is integral brain work mechanisms. Anticipation is not only spatial-temporary advancing but this or the degree of completeness and accuracy of prediction (56). As the authors specify, the concept of anticipation as an integral property of mentality carries out three essential functions in the world's reflection: communication, the interaction between people, and readiness to obey social norms. Papers (57) and (58) emphasized the variety of anticipatory mechanisms. It is anticipation that provides the formation and programming of behaviour and activity; it joins the processes of decision-making, current control, and communicative acts.

### 2.2. Judgement specifically pre-judgment

In Cognitive Psychology, Judgement is one aspect of human behaviour based upon considerable and sensible conclusions. It is the ability to make decisions or come to a sensible conclusion. Typically, judgement consists of sensible conclusions based on examinations, consideration of facts. However, according to a article (15), pre-judge is also based on certain assumptions—for example, innovation. Even though the judgment is very calculative and considerable, on the other hand, judgment before due examination and reflection of facts based on certain assumptions generally drive the development of pre-judge. It might be possible that pre-judge drives the hostile attitude towards the object. Pre-judge is usually challenging to alter. As per article (15), influential factors involve personal contact, mass media use, and economic developments in more comprehensive preservation.

### 2.3. Awareness

Different studies define Awareness differently, and there are many debates on the meaning of Awareness as it constitutes many aspects of consciousness and perceptions. According to the article (59), The science of biological psychology defines Awareness as perception and cognitive response to a situation or circumstance. As described by (60), Awareness is "the quality or state of being aware, consciousness and someone being "informed, cognizant, conscious, sensible." Moreover, it related to the state of simply knowing something and to occurrent Awareness. According to the article (61), Awareness is an ability to observe without needing thoughts. As individuals, we feel the need to label everything we observe, and therefore Awareness gets mixed with thoughts. Nevertheless, one realizes that an individual can be aware of the thoughts, feelings, and surroundings as a pure observer without judgments/interpretations. Overall, Awareness is redefined as the power of pure observation. The author also points out that people's Awareness develops as their brain develops.

Awareness also makes an individual see and identify negativity. Without the power of Awareness, detecting resistances and negativity may be a little more complex. However, it is easy-going to let in disapproval in case of an individual with low Awareness, which refers to “Negative Awareness as Low Awareness” by the author. By the study conducted by a paper (62), the author enlightens us that situation awareness originated with pilots as they attempted to articulate air combat challenges. The author refers to Situation awareness as the adaptive relation between an actor and an environment. The author mentioned that knowledge about the work domain or work environment, specifically complex environment influences professional situational Awareness. Failing to address it constructs a cause for tension results from a basic research program that has sacrificed meaning to achieve experimental control. The construct of situation awareness demands the problem of meaning to deal with head-on. Meaning must be considered, both in the sense of subjective interpretation (Awareness) and objective significance or importance (situation). We propose that a simple definition of SA might be congruent between the subjective interpretation of an event and objective measures of the actual event. The substantial equivalence between the interpretation and the objective situation means high situation awareness. Weak correspondence means low situation awareness. The author also believes that designing effective human-machine systems will set the agenda that basic research in human performance and cognition will need to follow with situation awareness. For our study and based on our understanding, we believe that Awareness related to acceptance can be divided into two categories such Awareness of people about the vehicle knowledge about the vehicle’s situation responses to the unpredictable circumstances, which could be divided partially aware and not aware, fully aware for our studies we selected these three. One of the articles, (63), clarifies situational Awareness or Situational Awareness or simply SA with the consideration of three basic questions as follow.

1. What do we see you around?
2. What does it mean?
3. What is most likely to happen next?

The answer relies upon an immediate answer to these questions. The better we immediate answer is, the more likely an individual prevent a disaster or accidents. According to the article above, the author highlighted that awareness must serve the best wit, a proper mindset. Biased opinions about only positives or only negatively affects situational awareness. The author’s analogy about the SA is like an AA meeting, which starts with honesty and admitting the vital truth and trying everything to resolve it beforehand.

#### **2.4. Attitude**

According to the article (64), attitude defined as “a mental state of readiness, organized through experience, exerting

a directive and dynamic influence upon the individual’s response to all objects and situations with which it relates, and Attitudes form in relation to objects, persons and values”. The author considered attitude as the most distinctive and indispensable concept in social psychology. The author stated attitude gives direction to one’s behaviour and actions. Attitudes are not innate but are formed due to an individual’s contact with the environment (15), Attitudes can have directions that fall under either favourable or positive and unfavourable or negative. We consider these directions play a significant role in terms of persons’ nature to view things and their ability to understand the perspective about it. Attitude provides insight into people’s behaviour and their background, which leads to overt behaviours. Attitudes are subject to change. Changes in attitude are generally not easily achievable by individuals unless intentionally subjected to the training and methods. It requires much discipline to change it. According to the article (65), Some behaviouristically inclined social psychologists refer to the attitudes as conforming behaviour. Once they are formed, they pressure the individual to react in a specific or characteristics way. Attitude denotes a functional state of readiness that determines the organism to react in a characteristic’s way to certain stimuli or stimulus situations. attitude is a learned or more or less organized tendency to respond persistently, usually negatively or positively, regarding some situation, idea, object, or class of such objects. A paper (66) views the term attitude; denotes the organization in an individual of his feelings, beliefs, and predispositions to behave. An attitude is a learned predisposition to respond in a consistently favourable or unfavourable manner to a given object. An attitude that is very often a deep-rooted component and resists most change. The article also mentioned attitude contributes towards the selectiveness of a person. Because of specific positive or negative attitudes, an individual or an organization either approaches it or avoids certain things. The author also stated that attitude could never be neutral. It can be positive or negative, favourable, or unfavourable and called the evaluative orientation towards the social world and measured. From the above standpoint, it is well palpable that attitude determines one’s behaviour.

#### **2.5. External Medium and Channels**

While our study observed that there are multiple terminologies, particularly as mentioned in the Pool Concept Map Fig 1, that have a significant influence on people’s psychology and further on their reaction, response, opinions, and point of view. From all the references and literature reviews we studied, we have selected a couple of points or categories which we believe influence people psychology more in general. Areas shown in Fig 2, Categories are 1. Social 2. Mass Communication. Under the social category, we divided it into three sub-categories Peer influence (Peer Pressure (67)), Experience (sub-points 1. In Close Proximity 2. Personal or

Past) and Bandwagon Affect. Under Mass Communication, we divided them into three categories 1. Mass Media (Mass media - Wikipedia (68)) 2. Alternate Media (Alternative media - Wikipedia (69)) 3. Social Media. A paper (35) explained in their empirical study about the travellers' trust and accept self-driving vehicles with the help factors affecting AVs as media affect, affecting self-efficacy and subjective norms, and ultimately lead to people's trust and behaviour change. The authors also mentioned about positive and negative reports greatly influence peoples' trust as well as; the author also highlights in their theoretical foundation study that peers influence is one of the reasons behind changing of social norms, and so do the people's surroundings and then their response and reactions (Peer Influence in Marketing (70)). The authors (71) and (8) also highlighted that public's intention to purchase and accept AVs or self-driving cars is not high. A paper (72) also mentioned that public acceptance of AVs is inversely proportional to the automation level. Papers (12), (73), studies significantly stated that respondents and individuals obtain the information related to AVs or related topic primarily from Mass Media. A paper (74) believes that positive information may convince consumers to use them. In extension to that, we add two sub-categories Mass Media which we include Films, Broadcast, Internet, Blogs, Print Media (Magazine, Newspaper), etc. and publications and Independent sources as Alternate Media and social media as we believe make a significant difference also (What is the Alternative Media (69)). One last terminology that we selected for the paper that we observed could influence the people's reaction, and a response is what we called "Bandwagon Affect," whereas explained in the article (Peer Influence in Marketing (70)), people usually influenced by their peers, specifically from a peer group. For Example, as a future hypothetical scenario, if an individual is living among the group of people who bought the AVs, an individual automatically reacts and responds positively about the particular thing. In such a scenario we believe, an individual's opinions and point of view significantly affect a person's choice.

### **2.6. Reactions, Response, Opinion and Point of view / Perception**

According to the article React vs Respond (75), reaction states as an instant driven by beliefs, biases and prejudices of the unconscious mind. When we react means an individual unconscious mind is running. The author also mentioned a reaction as a survival mechanism. One example where the author described the reaction is based on fear or embarrassment, or guilt; one of the psychological factors we mentioned in Fig 2. Though reaction and response are used synonymously, they are different from what we interpreted from the previous reference. On the other hand, the author mentioned response as slow feedback which come from the information from both conscious and unconscious mind and also other details con-

sideration and influence are more ecological as per the author include well-being and our surrounding; one of the factors which we relate as influential medium or channel for information gathering from Fig 2. The inclusion of terminologies such as Opinion, Perception or Point of View is similar to what we observed for response and reaction. As per www.merriam-webster.com definition, it is pretty clear that opinion is the view, judgment about a particular thing. We put this top section because, by definition, opinion usually consider as a formal expression, and as per our understanding, we considered it as the final catalyst in decision-making. On the other hand, according to Google's definition and Perspective vs Point of View Examples (76) and Point of View: Definitions and Examples — Literary Terms (77), perspective comes up through awareness and attitude towards something described point of view. However, for our study, even though they are quite different from each other, one common point on which we clubbed them together is because both come from someone's narration. So, we decided to put them into the same bracket as our study. It focuses on the individual itself and his or her decision making and factors that influence it.

### **3. LITERATURE CONTENT ANALYSIS AND THEORETICAL COMPARATIVE ESTIMATION TABLE (CET)**

From comparative analysis, we studied literature review, and from it, we observed quite the pattern of a hierarchical structure as shown in Fig 2. As shown in Fig 1, when interconnected, we believe this Fig 1 gives basic co-relations between terminologies, and we observed they all are interconnected but not organized and were not hierarchical or pool like pattern that we could observe while our literature reviews analysis. We observed all these terminologies are heavily interconnected with each other, as shown in Fig 1. So, we tried to channelize the information and try to summarise our understanding with more channelized way, so we believe Fig 2 is best to represent our understanding of literature reviews of considering primary (include journals, research papers, book etc.) and secondary (published web, independent, google searched articles on the internet) resources. Fig 2 is a reflection of our understanding and analysis of literature reviews we have gone through. The Fig 2 structure represents our analysis of the literature review with Hawking Publication Timeline template concept map of the Free Edraw Mind-master software version. The reason to choose the timeline template is to convey our understanding that the flow process of human behaviour and their thinking works down to up, as shown in Fig 2. We have divided the figure into three sections; at the top of the section is about people's willingness, acceptance of AVs.

The bottom section is the channel or mediums through which people receive the information. As explain in the Lit-

erature review section 2.5, we believe Mass Communication, which includes Mass Media, Alternate Media, and Social Media, basically plays a crucial role as broadcasting channels or medium to transmit the information to maximum people worldwide. After Mass Communication, Social influence is a powerful medium where we believe people exchange their ideas, communicate, share information, etc. Under this subsection, we believe that as explained in the literature review, Peer influence plays a significant role along with an individual personal experience or experience he observes in his or her surroundings as well as if an individual goes through any of the experience in Past like an accident or any other way then such social aspects play a huge role in person's psychology. The third medium that we believe could affect people's psychology is what we called "Bandwagon Affect" when people live in a group, we believe their choices and behaviour automatically incline towards their group circle. If influence is too strong, then there is a probability that an individual sometimes ignores his or her judgement or intuitions and accepts the feedback he or she gets from the group without analyzing all the facts.

Middle Section divides different Psychological elements, as explained in the literature review section above. Rather than go through complicated terminologies, we selected simple terms within psychology, such as emotion, social, cognitive, and biological, which we believe are essential influential granular elements. As we explained in our introduction section, we did not go into the complexity of terminologies. We selected and figured out simple emotion that people experience in day-to-day life and which we believe it can be commonly and majorly understand an individual without any confusion or misunderstanding. We aimed to study complicated terminologies used by the many authors when explaining the psychological aspects and bring down extraordinarily complex terminologies and break them down into simpler versions that ordinary people find easy to understand and recognize without any technical or literal sense clarification. We believe the terms we used, and we believe they are simple and commonly understood by an individual, belong to a sensible age bracket.

Top Section division points people's reaction, response, opinion and perceptive or point of view they established after completion cycle of information gathering through mentioned channels or mediums and influential factors administered by an individual. Based on a collection of responses, reactions, opinions and points of view or perception, we believe one can pretty much measure or evaluate an individual's willingness, acceptance towards a particular thing. In CET Table, we prepared the CET Table-Part1 and CET Table-Part2. We try to study comparative analysis of terminologies we studied from our literature reviews. After observing and understanding the terminologies we have gone through, we come

up with a theoretical CET analysis table, as shown in CET Table, which consists of CET Table-Part1 and CET Table-Part2 accordingly. CET Table-Part1 and CET Table-Part2 of CET are the two separate parts of the single table. For alignment, we have separated them apart. Much study builds on theoretical aspects. To measure our study accuracy or theory, we prepared the CET, which gives us better clarity on our theoretical study's truthfulness, which helps us understand our hypothesis and assumptions we believe, which would help for future studies. To prove a study or obtain a result, one must present proof of at least some statistical data analysis supporting that study or our case theoretical Comparative Estimation table (CET) we built. Therefore, we once again went through literature reviews and tried to find a solution for our problem, which is how we can present statistical data and its analysis; we could be used as a generalized method to measure our study's truthfulness. Therefore, after giving much thought and thinking to the quantitative analysis measurement, we came up with CET, shown in CET Table-Part1 and CET Table-Part2. Some of the challenges in front of us were basically to relate terminologies together, observe the pattern and hierarchy amongst these terminologies, decide the flow of each terminology's flow based on its significance and impact and last but not least how to measure these terminologies because many of them are psychology related. Some are social, and others are just mediums or channels. So, there is no proper meter to measure these terminologies as we do for weights etc. However, we settled on a solution towards placing these terminologies and an extraction of the quantitative data through them as we were looking for data that could provide us close "yes or no" or binary answers to our hypothesis and assumption we put in our discussion and future scope section. So, finally, we decided to go with CET as we called it (CET) as shown in CET Table-Part1 and CET Table-Part2, respectively, from a couple of references we study (13) and (14) as for further study researches can use any scales from these or other scales which we might not study or never come across. So, we decided to divide terminologies as follows, but even after the division of these terminologies to get close binary answers, further add-on references would be significant in addition to details and sacrificing simplicity and increasing complexity.

### 3.1. Worry

It is exceedingly difficult to measure the Worry, but for our Comparative Estimation study analysis, we have divided Worry into two sections where observers and readers better understand what we try to measure over here. As explained in our literature review, individuals worry about certain things when they know that outcome would be negative or incline towards adverse events. So, for our study, we believe worry could be measured in terms of distinct possibilities regarding events of negative expected or already occurred results



and uncertain possibilities of negative expected results which hold Min-to neutral level and Neutral-to-severe level of Worry according to our analysis definition of CET study.

### **3.2. Risk**

Risk is pretty straightforward compared to other psychological aspects because an individual easily recognized or measured risk in terms of low to high depending on its severity and priorities. When dealing with AVs, we will choose high risk as a ticked when people are under potential death situations or potential high injury situations or substantial financial loss of a vehicle. Other small injuries, financial losses and level of hesitation and so on that we could consider them under Low risk to High Risk.

### **3.3. Anxiety**

We have selected Anxiety because even though it is pretty much use as synonyms to worry as a part of fear, Anxiety is about something unavoidable. If an individual has Anxiety about something or certain things, we can not avoid it, but it is possible to overcome it through information or to convince in case of worry. So, we believe in measuring Anxiety, we can divide Anxiety into Minor or Severe Anxiety. In minor Anxiety, people still fearless, and there is a slight possibility that people win over their Anxiety. However, in the case of server anxiety, it is pretty difficult to convince people or make them feel confident or assure about a particular thing, especially in AVs safety-related issues.

### **3.4. Trust**

Trust is pretty much more straightforward than all because trust is a universal concept, and people easily distinguished between trust and untrust or distrust. There is the possibility of neutrality, but we deal with trust and distrust to get binary answers. Parameters on which we based our measurement are predictability, dependability or reliability and faith. Though they are pretty complicated terminologies themselves, we based our measurement of trust and distrust accordingly if we observe such terminology.

### **3.5. Attitude**

As we explained from the literature review, anticipation depends on the readiness of people about certain things. If people are ready to do a certain thing or, in our case, show readiness, then we could mark it as a positive attitude; otherwise, it would mark as a negative attitude.

### **3.6. Prejudge**

As explained in the literature review section, prejudgment of people about things are based on certain assumptions. Peo-

ple generally assume many things when they see or observe certain things without any prior knowledge or full knowledge. According to our study of literature reviews section, which we presented above, prejudice could be divided into a component of low magnitude assumptions and high magnitude assumptions.

### **3.7. Anticipation**

As explained in our literature review study section's examples, anticipation usually is based on comfort with the consideration of future events. If people see comfort, people show positive anticipation; contrarily, people's discomfort and negative feelings will lead to negative anticipation.

### **3.8. Awareness**

Here, the Awareness we measure in terms of people's knowledge about AVs and how transparently the information or knowledge is provided to the customer or driver. One of the things we observed while doing our study is that if an individual knows about how his or her machine in this scenario AV vehicle acts under certain circumstances, then it would increase an individual's situational Awareness, which would be much productive in terms of avoiding certain unfavourable events in future. So, we divided our study awareness into Low and High Awareness.

### **3.9. Mass Communication**

As per the literature reviews section 2, Mass communication we divided into Mass Media which include Internet, Film, Web Blogs, RSS feed, Podcast, Print Media etc., Alternate Media which we divided into two section publications published explicitly by a highly knowledgeable individual or article writers and the second one is Independent Sources. We also include Social Media because social media's influence is massive through Social Apps or Instagram short videos, ads, etc.

### **3.10. Social Interaction**

This section divides into three things Peers influences, as mentioned in the literature reviews section 2. The second one is an experience which further divides into two sub-categories depending on where an individual observe or gain experience from for example in close proximity or in his surrounding which nearer to his or her or whether he or she or his social group had an in-hand experience or any past experience of himself or close to him or her caught in an accident or any other incident. Last but not as significant, we believe Bandwagon Affect also one of medium or channel through people gain information about certain things which influence their reactions, reasons, opinions and perception, point of view. As explained in the literature review section, a person hangs

around a specific group of people or a particular community has possessed the AVs, then a person does feel a slight tilt or a slight inclination towards such thing. Trending specific things also hugely influences a person's psychological ability, which affects his decision-making.

#### 4. LIMITATIONS AND CHALLENGES

All of our studies based on fundamentals factors we observed, and we believe would most likely affect each individual's decision-making. So, we attempt to target aspects that we believe could be generalized. We do realize that each person is unique and possesses individuality, which might represent whole different scenarios and variations. We also try to avoid lots of terminologies which we observed, such as Safety, Experience, Choices, Beliefs, Expectations, and others because we believe the terminologies which we used in this paper are at the fundamental and atomic level than mentioned terminologies which are more of complex and may or may not constitute the terminologies which we covered as a single or in a combination.

CET, which we presented, we tried to simplify the terminologies as more uncomplicated as possible. We decided to put the complex field of psychology in the CET, where we tried to evaluate terminologies and try to find binary answers to measure the complex psychological aspects and terminologies. Even though we are not from the psychological field nor we have expertise in the field, but through literature review, we try to analyze the human aspects, particularly from the content we collected or content study we performed on literature reviews we studied so far. Even with our limited resources, we try to establish a pattern and structure through which we believe could open lots of ideas for researchers interested in combined science of psychology and technologies that is, in our case, our focus on AVs. We have known that our research has some limitations because we realize the magnitudes of fields we tried to interconnect in this paper.

Some of the fields and some terminologies within the fields we used in this paper are incalculable. For example, fear, (78) explained and stated risk has an element of calculation to it, but on the other side, fear is more incalculable. Thus, we try to select terminologies in-depth, which provide us some what vision of calculable answers and solutions for incalculable terminologies. We try to break those terminologies into a sub-atomic level, but we expect some possibilities or studies might we never come across, which could break them into a sub-atomic level to provide further clarification and better measurement than what we try to achieve in the paper.

#### 5. DISCUSSION AND FUTURE SCOPE

In this paper, we tried to analyze psychological aspects related to Willingness, acceptance of AVs. Rather than under-

standing the complicated terminologies we observed in literature reviews, we analyze and selected necessary ingredients that affect and influence human behaviour and psychological aspects. Along with that, we also observed, and we believe some aspects which work as catalysts such as medium or channel through generally people receive and gather the information. After our observation and analysis, CET we prepared, we believe this could be used as a fundamental for future study related to AVs specifically relate to psychological aspects and the effects of medium and channels on human behaviour once an individual receives information. CET, we prepare could be useful with the addition of (13) and (14) or any other scaling models to further in-depth knowledge. CET Table- Part 2 can also be useful for categorizing materials or references if we want to choose them as columns. We could also choose a whole table and any reference we selected; we could use it to evaluate parameters that reference. We strongly believe that our study; This table or chart helps create better survey questions when dealing with human aspects. Secondly, it connects the link between human understanding and autonomous technologies and even further any future technologies to target people's acceptance solutions. Thirdly, many Companies nowadays spend much time marketing their products and their features but hardly focus on fundamental factors that need to convey to attract the customers and resolve their issues and doubts to increase their awareness about the doubts they have related to the product explicitly related to autonomous vehicles. Fourth, many current advertisements focus on AVs' high-tech features, but we passionately believe that once manufacturers and companies start targeting these factors, they could attract the customer very quickly compared to the current speed.

For our future study, we plan to target various references, primary and secondary published like Articles, news, journals, blogs, and others and will try to evaluate our CET's truthfulness with the creation of some hypothesis and verify our results to understand the efficiency of our CET. We also aim at collecting the data from our primary and secondary resources to present the statistical analysis, which we believe will enable us to evaluate our CET in-depth and its efficiency. CET will also provide insights into some of the ideas and parameters or details that might miss or need improvement. We will also try to update the CET in the future along with data collection and its analysis and add improvements if we observe that need to be added.

#### 6. CONCLUSION

Psychology and Autonomous Vehicles (AVs) are extensive topics individually. Both include extraordinarily complex terminologies, especially Psychology. Complicated terminologies generally are a combination of multiple atomic concepts interconnected with each other. While working on our paper, we observed much research conducted in both fields, but the

focus was mostly independent concerning the concentration of either the technical side or psychological side. There is limited research on Willingness, Acceptance of AVs where many authors tried to relate psychological and technical aspects together, but typically psychological concepts and their interconnection with human behaviour, human decisionmaking, which ultimately regulates the willingness acceptance of AVs used with complicated terminologies. In our paper, we decided to place an effort to understand those concepts at a granular level and presented our observed pattern, structure as well as CET through our understanding of the literature reviews, we studied. Even though with limited literature reviews resources we mentioned in the bibliography, we believe our analysis and CET will provide future researchers and companies (particularly in the marketing of AVs) some insight and understanding about people, their decision making, psychological aspects which influence them as well as channels or mediums through which they receive the information which ultimately helps to grasp people's willingness, acceptance patterns. In future, we can not deny possibilities that if we manage to present statistical data as well as able to recognize which psychological aspects, medium or channels influencing the people decision making, willingness, acceptance about remarkable new innovation or technology, then companies will tackle the challenges efficiently and come up with solutions in more productive way lessening the timeline of these technological innovations which generally takes ages before entirely accepted.

7. TABLE, DIAGRAM AND CONCEPT MAP

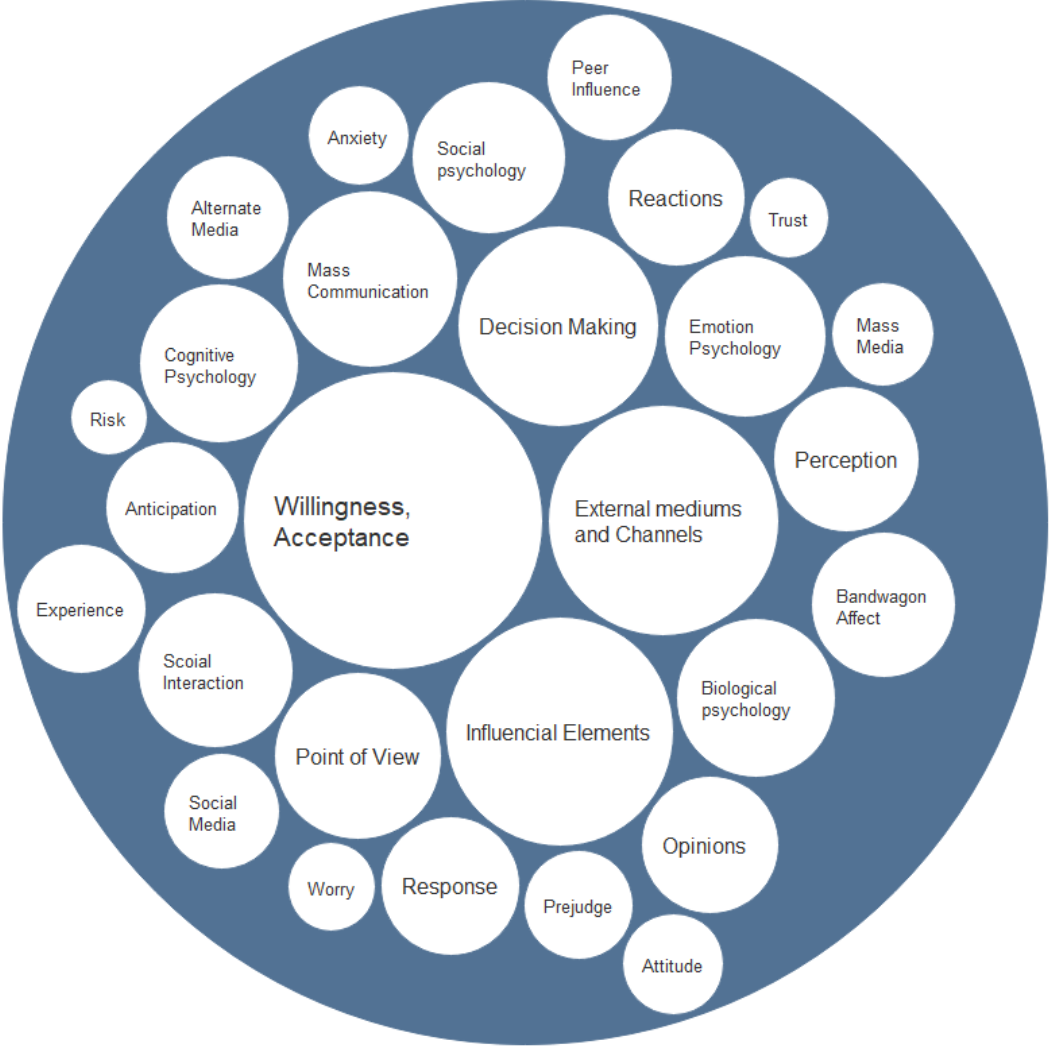
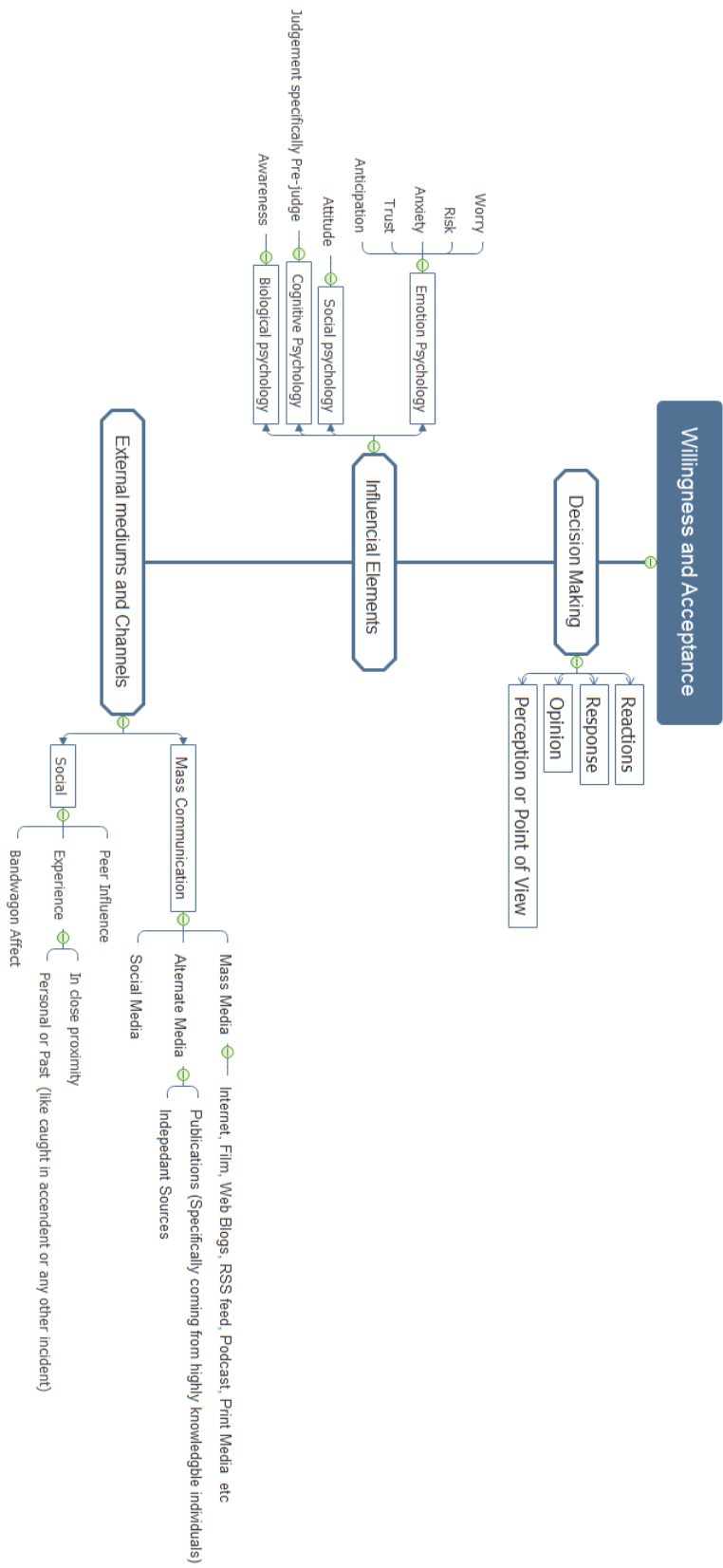


Fig. 1. Pool Concept Map



**Fig. 2.** Hierarchical Concept Map

|                        |   |   |      |      |         |        |       |          |              |          |               |                |                           |                            |            |      |
|------------------------|---|---|------|------|---------|--------|-------|----------|--------------|----------|---------------|----------------|---------------------------|----------------------------|------------|------|
| References<br>to Study | Psychology                                |   |      |      |         |        |       |          |              |          |               |                |                           |                            |            |      |
|                        | Emotion                                   |   |      |      |         |        |       |          |              |          | Social        |                | Cognitive                 |                            | Biological |      |
|                        | Fear                                      |   |      |      |         |        |       |          |              |          |               |                |                           |                            |            |      |
|                        | Worry                                     |   | Risk |      | Anxiety |        | Trust |          | Anticipation |          | Attitude      |                | Prejudice                 |                            | Awareness  |      |
|                        | Certain possibilities of negative results | Uncertain possibilities of negative results | Low  | High | Minor   | Severe | Trust | Distrust | Positive     | Negative | Low Readiness | High Readiness | Low magnitude assumptions | High magnitude assumptions | Low        | High |

**Fig. 3.** CET Table- Part 1

|                        |                     |                 |              |                    |  |                  |                  |              |
|------------------------|---------------------|-----------------|--------------|--------------------|--|------------------|------------------|--------------|
| References<br>to Study | Mediums or Channels |                 |              |                    |  |                  |                  |              |
|                        | Mass Communication  |                 |              | Social Interaction |  |                  |                  |              |
|                        |                     |                 |              | Peer Influence     |  | Personal or Past | Bandwagon Affect |              |
|                        | Mass Media          | Alternate Media | Social Media |                    |  |                  | Trending         | Non-Trending |

**Fig. 4.** CET Table- Part 2

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