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On Origins of Sadness and Happiness

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Abstract:
A new way of characterization in terms of "fundamental" emotions is proposed. This is explained in the first section thereby characterizing some emotions as fundamentals and others being derivatives of those fundamental feelings. There are some feelings that are shared across all cultures and individuals. These universal emotions consist of fear, hope, anger, etc. among others. In this paper, it has been tried to illustrate that two such feelings, namely, sadness and happiness, are not the fundamental feelings but are actually derived from other fundamental emotions, namely, fear and hope, respectively. This illustration is shown to be supported by findings in neuroscience, statistical studies done by psychologists, Darwinian theory of evolution and the prospect theory in economics. A holistic approach has been attempted to be incorporated as far as possible, to illustrate the point. Some consequences of these analyses are also sketched and a detailed discussion has been done on the feelings of sadness and happiness when taken together in the context of any individual. Though this way of characterization of emotions is much broader, but in this paper this has been applied only to the feelings of sadness and happiness that are shown to be derived from fundamental feelings of fear and hope respectively.

Keywords: *Sadness, happiness, fear, hope*

1. Introduction

Cultural anthropology deals with individuals in the context of their respective societies taking into account of their past and present conditions. There are various characteristics that vary across cultures. But there are some kinds of feelings that tend to persist across all cultures among all individuals. These universal feelings are actually addressed by psychology. Some examples include fear, hope, anger, jealousy, etc. among others. In this paper, characterization and origins of two such universal feelings of sadness and happiness will be discussed and will be illustrated that they are actually secondary in nature. They arise from other universal feelings of fear and hope respectively. One of the important features of fundamental feelings, as illustrated in this paper, is that experience does not play any role in feeling these emotions. But the derived feelings require experience in order to be felt. As a note to the author's convention, two words, namely, "feelings" and "emotions" will be used interchangeably in this paper.

Before starting this paper, it must be clarified by what "fundamental" means. It is a way of characterization, as proposed by the author, consisting of those emotions that are independent of each other and further, are not derivatives of some other kinds of emotions. Being fundamental, they are natural and universal without the requirement of experience in order to be felt. These emotions must be felt by the fast and intuitive part of thinking alone (which is referred to as *System 1* of brain by Kahneman in [3], see Section II for more) and there must be no need of the slow and reasoned part of thinking (correspondingly referred to as *System 2*, see Section II). This definition of "fundamental" directly flows from its scientific meaning. Now this way of characterization is really helpful but for this to work, a holistic approach becomes mandatory to the maximum extent possible because all emotions that are hypothesized to be fundamental must be independent in all sense. In case of an emotion where it gets overshadowed by another kind of emotion definitely is not a fundamental emotion. In this paper, two universal feelings of sadness and happiness are explored and are found to be derived from fundamental feelings of fear and hope respectively. It is to be noted at this point of time that "fear" and "hope" are two independent emotions. They are neither one-dimensionally opposite to each other, nor do they happen to overlap each other at a basic level.

2. On Choice (A Review)

Most of the pioneering works in choice theory and prospect theory in behavioral economics were done by Daniel Kahneman and Amos Tversky. Together they argued in their works ([1], [2]) the psychological (and more effective) way of doing economics. They removed one of the hypotheses of assuming individuals to be rational as assumed in the *utility theory*. Based on irrationality of individuals, they developed prospect theory that is going to be very useful in the analyses done in this paper. This section is a brief overview of their work ([1], [2]) which is going to be used in this paper. Materials presented in this section are far from original and the author does not claim of anything in this section. At places, the author has used exactly the same examples as used in the corresponding original works cited in there.

They argue beautifully in their papers that individuals are not accustomed to think *statistically*. The functioning of brain is of two types: one that is intuitive and fast (which Kahneman calls System 1 in his book), other reasoned and slow (which he calls System 2). Kahneman presents this idea in one of this bestseller books *Thinking, Fast and Slow* ([3]). The fast aspect of brain (System 1), though essential for survival, takes decision hastily and is not accustomed to think statistically. Using an example by Kahneman ([3]) to illustrate this point, consider the following description:

An individual has been described by a neighbor as follows:

→ "Steve is very shy and withdrawn, invariably helpful but with little interest in people or in the world of reality. A meek and tidy soul, he has a need for order and structure, and a passion for detail." Is Steve more likely to be a librarian or a farmer?

Immediately, the fast brain (System 1) gives the response that this description is likely to be that of a librarian. System 1 is used to *stereotypic thinking*. But this response directly goes in the face of statistical analysis. There are far more farmers in this country (India) than there are librarians. So statistically speaking, there is a far more *probability* that the above description matches that of a farmer because probability doesn't take into account the stereotypical aspects. This part of analyses (thinking in statistical terms) comes to form opinions only after System 2 (reasoned and slow) is used. This beautiful example illustrates that our intuition is not at all tuned to statistical thinking. Since System 1 is so important for survival (even when seen in the light of Darwinian theory of evolution), hence this conclusion has profound aspects on our choices which are made in daily life. Thus, the assumption of taking individuals to be rational while making choices is definitely a poor assumption to develop economics. Kahneman ([3]) shows that statisticians are also bound to make this error while making choices and taking decisions. Other more quantitative examples will also be presented in due course of this paper.

Now while making choices, whether by System 1 or System 2, risk plays a very dominant role that in turn affects our decisions. Hence *risk averse* and *risk seeking* are important concepts to be analyzed statistically to better understand the decision theory. Reproducing the graph from the research paper [1], figure 1 is obtained. This graph is rich of information and is going to be used in this paper. Hence this graph needs some explanation. The graph deals with the psychological values of losses and gains which individuals tend to assign to deals. The origin is the neutral point, right of which shows gains and left to which shows losses. Y-axis labels the psychological values assigned to them. A careful analysis of the graph shows that the curve is not symmetrical about origin, the slope of the function being changed abruptly at the origin. In the first quadrant, the graph is less steep than in the third quadrant where there is steeper slope near the origin. This *asymmetry* of being steeper in the third quadrant shows that psychological values assigned to response to losses are much stronger than to response to gains. Hence individuals do not tend to think of losses and gains as equal and opposite, a sharp distinction from a rational agent (as considered in utility theory) who is assumed to treat them as equal and opposite. Individuals tend to be more sensitive to losses than gains and this fact that fear of loss is stronger than hope for gain will play a role of considerable importance in this paper.

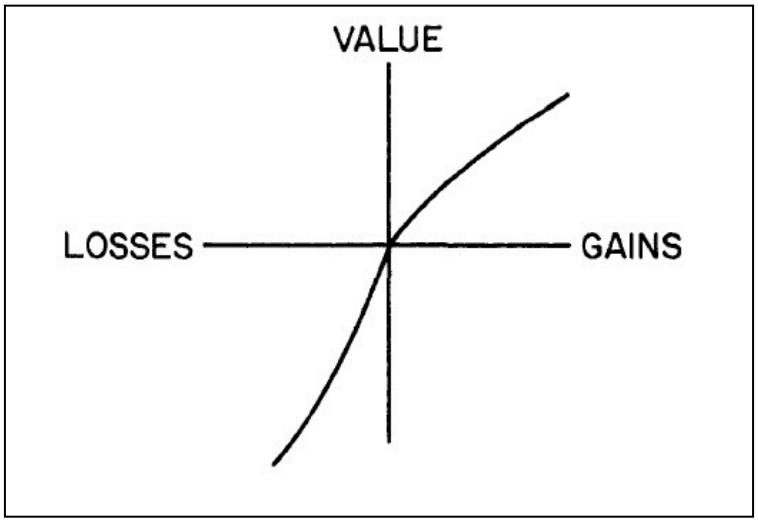

Figure 1

This tendency, to avoid losses more severely than to have gains, is ever present in daily lives and in all negotiations. Hence the natural tendency to defend the status quo is more natural ([3]).

Next, consider the situation where a lottery ticket is to be bought. Intuition tells that the value of ticket is not proportional to the probability of winning. This is expected because individuals are not evolved to think statistically as noted above. The graph of decision weight assigned to purchasing the lottery ticket versus the probability of winning is as follows (reproduced from [1]):

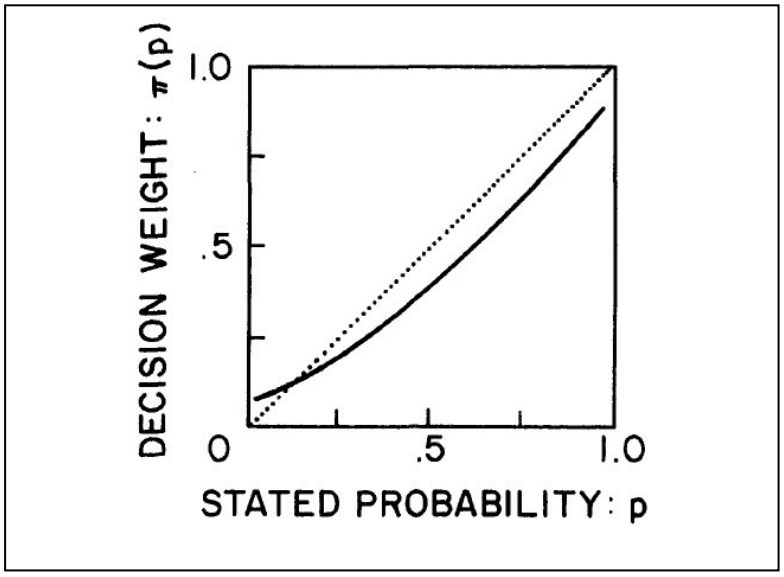

Figure 2

Dotted lines in figure 2 show the actual probability that is expected out of a rational agent. Bold line clearly shows that the relationship is not at all linear and in the moderate and high probability zones, decision weight tends to be lower than that of actual probability assigned. This *nonlinearity* of decision weights with probability can be illustrated by the following example (reproduced from [1]):

Problem 1: Consider the following two-stage game. In the first stage, there is a 75% chance to end the game without winning anything and a 25% chance to move into the second stage. If you reach the second stage you have a choice between:
A. a sure win of $30
B. 80% chance to win $45

Your choice must be made before the game starts, i.e., before the outcome of the first stage is known. Please indicate the option you prefer.

Problem 2: Which of the following options do you prefer?
C. 25% chance to win $30
D. 20% chance to win $45

Majority view tends to favor prospect A in problem 1 while prospect B in problem 2. But it is to be noted that prospect A has a probability of 0.25 X 1 = 0.25 to be won because there is only ¼ chances to get to the second level. This is same as prospect C. Further note that prospect B has a probability of 0.25 X 0.80 = 0.20 to be won. This is same as prospect D. Hence problems 1 and 2 are exactly the same in terms of probability. They are the same problem with same chances, formulated in different ways. Hence the assumption of rational agent would have given the same choice in both the problems(a *linear* dependence of decision weights on probabilities) which is clearly not the case (a *nonlinear* dependence of decision weights on probabilities), thus violating the assumption of rational agent.

Finally, the boundary effects in probabilities are also interesting to be noted. It is easy to understand intuitively that making choices differ drastically when the probability of an event to occur changes, say, from 0% to 5% (*possibility effect*) or from 95% to 100% (*certainty effect*) rather than, say, from 30% to 35% (intermediate probability range). Such boundary effects are quite interesting in prospect theory and decision theory. Suppose there is a 95% chance to win a lottery of worth $5,000.So there is almost a sure chance to win the lottery. Hence accordingly, *fear of disappointment* is very large over other feelings like hope to avoid loss, hope of large gain and fear of large loss. Hence majority of the individuals tend to be *risk averse* in this case. Correspondingly, they will prefer to go on to *accept unfavorable settlement* rather than go for this fear of disappointment. This is a *high probability certainty effect*.
Similarly, suppose there is a 5% chance to win a lottery of worth $5,000. So there is almost no chance to win the lottery. Hence accordingly, *hope to large gain* is very large over other feelings like fear of disappointment, hope to avoid loss and fear of large loss. Hence majority of the individuals tend to be *risk seeking* in this case. Correspondingly, they will prefer to go on to *reject favorable settlement* and go for this hope to large gain. This is a *low probability possibility effect*.
These effects are dominant because individuals tend to think not in terms of statistics and probability as noted before. There are other cases too, all can be summed up by a "fourfold pattern" (as Kahneman calls this in [3]) and can be described by the following chart (reproduced from [3]):

	GAINS	LOSSES
HIGH PROBABILITY Certainty Effect	i) 95% chance to win $5,000 ii) Fear of disappointment iii) RISK AVERSE iv) Accept unfavorable settlement	i) 95% chance to lose $5,000 ii) Hope to avoid loss iii) RISK SEEKING iv) Reject favorable settlement
LOW PROBABILITY Possibility Effect	i) 5% chance to win $5,000 ii) Hope of large gain iii) RISK SEEKING iv) Reject favorable settlement	i) 5% chance to lose $5,000 ii) Fear of large loss iii) RISK AVERSE iv) Accept unfavorable settlement

Figure 3
("Fourfold Pattern": Boundary Effects)

3. On Sadness

Sadness is a universal feeling. It is really essential to cope with losses. It has its evolutionary advantages too as will be discussed shortly. But however universal it is, it is not a fundamental feeling. It is derived from the other fundamental feeling of fear. Fear is a fundamental universal feeling, which is felt by both children and adults without much need of experience to actually feel this. Fear can be of various types: fear of loss, fear of losing a relationship, fear of death, etc. All these emotional fear tend to lead to sadness. But to actually feel sadness, experience is an important criterion. Once the fear is realized, the feeling of sadness (magnitude depending on the context) erupt which then helps to cope up with the loss suffered. But an important point to be noted is that it actually requires an experience (of having realized a fear in life) for sadness to be felt. This is not valid for the feeling of fear. Prolonged sadness further leads to depression and pessimism (can be read as under confidence too in this paper). Prolonged exposure to fear also has similar effects. Pessimism in turn leads to the more strong feeling of becoming risk averse. Tendency to take risks reduces substantially. This tendency of loss aversion dominates the characteristic of that individual which in turn affects the choices made by that person as seen in section II of this paper. Hence, fear actually plays the dominant role behind sadness. Other feelings like pessimism, depression and loss aversion follow directly from the emotion of fear too. In case when fear is not realized and a person does not have any experience of such realizations, does not rule out the tendency to feel fear. Fear persists and this *prolonged* exposure to fear also lead to sadness and further makes the person loss averse. Here too, time plays a dominant role (hence can be counted as experience) in being exposed to a sense of fear (say, of loss) which leads to sadness.

Fear leads to affecting choices severely. In figure 1, this sense of fear (of loss) is more dominant than the hope (of gain) and is evident by having a more steeper slope in third quadrant than in the first quadrant in the region near origin (hence making the curve asymmetrical about origin). This is one of the main reasons that in figure 2, the actual decision weight (solid curve) assigned is less than the actual probability (dotted curve) in regions of moderate and high probability. The fear of loss actually causes this difference. *High probability certainty effect* in gains and *low probability possibility effect* in losses are similarly due to this feeling of fear. When these fear are realized, this leads to sadness and makes that person more risk averse than risk seeking. This is summarized in figure 3 too and can be better explained using the present characterization of sadness being derived from fear of loss.

Evolutionary analyses of sadness also support this viewpoint. Fear has always played a major role in determining the survival of the fittest. Fear of death, fear of loss of a relationship, say, of a mother with her child, etc. have played dominant roles in the survival of the species of Homo sapiens. Wolpert ([4]) illustrates this point in his paper. During the course of evolution, fear has caused individuals to avoid situations that are dangerous. This is of course important for survival. This sense of fear has led to the sadness only when that fear is realized and sadness becomes adaptive to cope up with the losses incurred. Similarly, attachments like the bond between a mother and her child are adaptive from an evolutionary point of view and the sense of fear of losing these relationships obviously lead to an immense feeling of sadness when such relationships are lost, say because of death of a mother's child. Here too, sadness becomes adaptive for the mother to actually cope with the loss.

As pointed above, prolonged sadness or exposure to fear may lead to depression. This needs few comments. Wolpert ([4]) has argued that sadness is the closest feeling that is linked to depression. Feeling very sad is actually one of the kinds of low level of depression. This is so because it is very difficult to diagnose depression as no clinical test exists for its diagnosis. Horwitz and Wakefield ([5]) have emphasized in their work that clinical depression is very much over diagnosed. But there are kinds of depression like Seasonal Affective Depression (SAD) that are actually adaptive, caused by lack of light and happen mostly in winters and mainly in northern countries. Women are more prone to these than men. But whatever the case may be (as many points are discussed in this paragraph), this is undeniable that there is a very close connection between sadness and depression and prolonged sadness actually takes the form of depression, despite of the fact that it has been argued in literature that the latter has no evolutionary adaptive advantage (see[4]). The next natural question arises that actually what causes this sadness to convert to depression? One of the reasons is prolonged exposure to fear or sadness (if fear is realized in experience of an individual) and already has been pointed out in this paper. But sadness is a complex emotion. Other plausible reasons, as pointed out Wolpert ([4]) is that interaction of sadness and negative cognition may lead to depression. A positive feedback loop between biological reasoning behind sadness and psychological reasoning behind sadness may also lead to depression. Further, *genetic disposition* and hormones like *cytokines* produced by the immune system may also lead to it.

Next, as pointed above, is the relationship between fear and pessimism. As pointed above, fear causes an individual to become pessimist. The individual exposed to the feeling of fear of loss, fear of pain, etc. tends to become more and more loss averse. Their

capacity of risk estimation reduces substantially and the outcome is risk aversion. This is supported by a detailed study done by Lerner and Keltner ([6]). They also show that angry individuals tend to be more risk seeking like happy people but this is not the point of interest here. The feeling of fear affects the understanding of judgments in manifold ways. Since perception of risks form a basis of many decisions in day to day lives of individuals, hence the feeling of fear leading to making pessimistic judgments have profound effects. This supports the viewpoint as held in this paper that pessimism and risk aversion arise from the feeling of fear.

An illustrative example to further show the relationship between the feeling of fear and sadness, thus on life satisfaction is that of political instability and terrorism. Terrorism comes with an intense fear of loss, fear of death and fear of pain (in cases of being held as a captive and physically or mentally tortured). In cases of terrorist attacks, this fear takes form of immense sadness and depression. Sadness becomes important to cope with losses. Even in cases where terrorism prevails but no attacks happen, the prolonged exposure to various types of fear (as noted above) lead to sadness and pessimism about the quality of life in general. This directly impacts the living standards of individuals. Thus political instabilities and sadness arising from fear are very closely related. To support this analysis, a study was conducted Frey and Stutzer ([7]) in France. For 15 terrorist attacks that happened in France (mostly Paris) between 1973 and 1998, it was found that number of terrorist attacks had a statistically significant negative effect on the living standards on individuals. Further in France, it was found out that Paris being more prone to terrorism, individuals residing in Paris were willing to pay around 14% of their income to lessen terrorist activities when compared to individuals residing in comparatively peaceful parts of France. Similar challenges like terrorism to humankind have similar effects whether the challenge is of financial instability, communicable diseases, hunger or any socio-economic challenges, the dominant role of fear and its relation with sadness and pessimism is evident.

Finally looking from a point of view of neuroscience, a consistent picture emerges. The feeling of sadness indeed emerges from a sense of fear of displeasure. While that of happiness emerges from the feeling of hope for pleasure. In a detailed study conducted by Wilson-Mendenhall et. al ([8]), participants were made to listen to daily scenarios and adventurous cases like a roller coaster ride while their brains were scanned in a fMRI (functional Magnetic Resonance Imaging) machine. They were asked to report their levels of fear of displeasure and hope for pleasure. The researchers found that brain activities in *amygdale* increased whenever the feelings of fear and sadness among other feelings (but interestingly not including hope and happiness among others).Amygdala is the region of brain that is mostly associated with arousal and fear. This is a clear evidence of *separateness/independence* of the feeling of fear from the feeling of hope (accordingly the *separateness/independence* of feeling of sadness from feeling of happiness) as expected and argued in this paper under a "fundamental" classification of emotions.

4. On Happiness

Happiness is another universal feeling like sadness but less prevalent, reasons of which will be highlighted and illustrated shortly. It is essential in cherishing for something good that has happened to an individual, according to that individual. This boosts confidence and allows to develop a perception of risks such that to make that individual more of a risk seeker. Again, like sadness, however essential it is, it is not a fundamental feeling. It is derived from the fundamental emotion of hope. Hopes can be of several types, like, hope for success, hope for a good standard of life, hope for less suffering, hope for pleasure, hope for miracles in adverse conditions, etc. This feeling of hope is independent of the feeling of fear. No matter how much the feeling of fear persists, there is always a hope (say, for miracles) and this makes the emotion of hope a fundamental feeling. When the hope is realized in experience of an individual, that individual tends to become happy and thus, the feeling of happiness comes. The crucial point to be noted is that to feel hope, experience is not required but to feel happiness, experience of realization of hope is an important factor. The psychological state of happiness tends to make individuals more risk seeker than avoiding risk ([6]). This is in sharp contrast (as expected) with the feeling of sadness which makes individuals more risk averse. But how much risk seeker an individual become, most decisions of that individual are always guided more by fear of loss than hope for gain as clear from figure 1, where slope in the first quadrant is less steep than that in third quadrant. Prolonged feeling of hope makes an individual optimistic but sometimes with a fatal error of undermining the appropriate perceptions of risks. Similarly, prolonged happiness tends to make an individual overconfident that again affects the ability of that individual (sometimes severely)to perceive risks, making that individual prone to serious judgment errors. Whatever the case may be, the feeling of happiness is derived from the feeling of hope. Other feelings like confidence, overconfidence, optimism and risk seeking follow from this feeling of hope too.

Hope often leads to forming of choices though not at par with fear. In figure 1, it can be seen that the slope of the graph is less steep in the "gain region" than in the "loss region". Further the feeling of hope is actually responsible that in figure 2, the actual decision weight (solid curve) assigned is more than the actual probability (dotted curve) in regions of low probability. The hope of gain actually causes this difference. *High probability certainty effect* in losses and *low probability possibility effect* in gains are similarly due to this feeling of hope. When these hopes are realized, this leads to happiness and makes that person more risk seeking than risk averse. This is summarized in figure 3 too and can be better explained using the present characterization of happiness being derived from hope for gain.

Buss ([9]) starts his paper with the following lines: "Happiness is a common goal toward which people strive, but for many it remains frustratingly out of reach." The second line is justified by this fact that fear plays a dominant role in our decision making and risk perceptions rather than hope. This is evident from figure 1 too where more psychological values are assigned to fear of loss than hope for gain. Evolutionary psychology of happiness provides a deep understanding too. The adaptive advantage of happiness in evolution lies in the better living standards of individuals. Since there is a thin line difference between confidence and overconfidence (like immense sadness and depression), hence the tendency to make individuals more risk seeking is an advantage or not, is debatable. Barkow ([10]) has argued that perpetual state of happiness is most certainly maladaptive. Since improving the living standards is

certainly a very difficult task, hence the feeling of happiness is not very dominant as that of sadness. Speaking evolutionary, the feeling of happiness is derived from the feeling of hope. This is so because happiness is adaptive in evolutionary process as happiness leads to coalitions, friendships, kinships etc. that are a must for individuals to survive in groups and carry the legacy forward by reproducing. But this happiness is derived from hope for cooperation, depth, closeness etc. respectively, thus forming a cooperative coalitions, deep friendships, close kinships, etc. ([9]).This can be stressed in this evolutionary context too that hope for cooperation, depth, closeness etc. does not need experience but to feel happiness derived from them, one actually has to go through the act of experiencing them. Hence the evolutionary picture definitely supports the characterization that has been proposed in this paper. Finally it too can be pointed out that it is intuitive that the fear to lose is again dominant over hope for gain. As seen above, the feeling of fear makes individuals avoid dangerous situations. At the same time, hope (for pleasure) has encouraged the individual to repeat those acts, like sex, which are of immense importance in evolution in order for a species to survive. The very fact that these acts are pleasurable is because of their survival advantage and added to this the psychology of hope (for pleasure) causes the individual to repeat such acts.

Next is the relationship between hope and the tendency to seek risk. Hope for gain leads to happiness when that hope is realized in the experience of the individual. This in turn leads to *confidence*. No loss and only gain leads to *overconfidence*. In other words, prolonged state of happiness converts confidence to overconfidence. The psychological conditions of confidence and overconfidence both tend to support the tendency of seeking the risk. In case of overconfidence, the perception of risk is hampered severely and the sense of loss is undermined hugely while taking decisions. A study done by Lerner and Keltner ([6]) shows that angry and happy people tend to be more risk seeking than sad people. This study completely supports the analyses done in this paper.

An illustrative example to show the relationship between the feeling of hope and happiness, thus on life satisfaction and living standards is that of marriage. Marriage comes with a great amount of hope where partners hope for a mutually rewarding exchange, tied together in a hopefully long-term relationship. Studies ([7]) have shown that married individuals tend to be more happy and satisfied life than unmarried individuals. Marriage is evolutionary advantageous too where individuals indulge in acts like reproduction to carry the legacy forward and also provide emotional and financial support, thereby reducing risks of depression and suicidal tendencies among other dangerous feelings. Of course, these are just hopes. The reality may vary. But the fact that this hope exists in the act of marriage is the source of happiness. But as often happens, hope is set much higher and when faced with reality in the experience of an individual, the actual level of happiness tends to be lower than expected. A study conducted by Frey and Stutzer ([7]) reveals this point. They plotted a graph of average life expectation versus years before and after marriage. This study was based on 21,809 observations for 1,991 individuals in Germany between 1984 and 2000. Various factors were taken into account. They included respondents' sex, age, education level, parenthood, household income, household size, relation to the head of the household, labor market status, place of residence and citizenship status. The graph obtained was (reproduced from [7]):

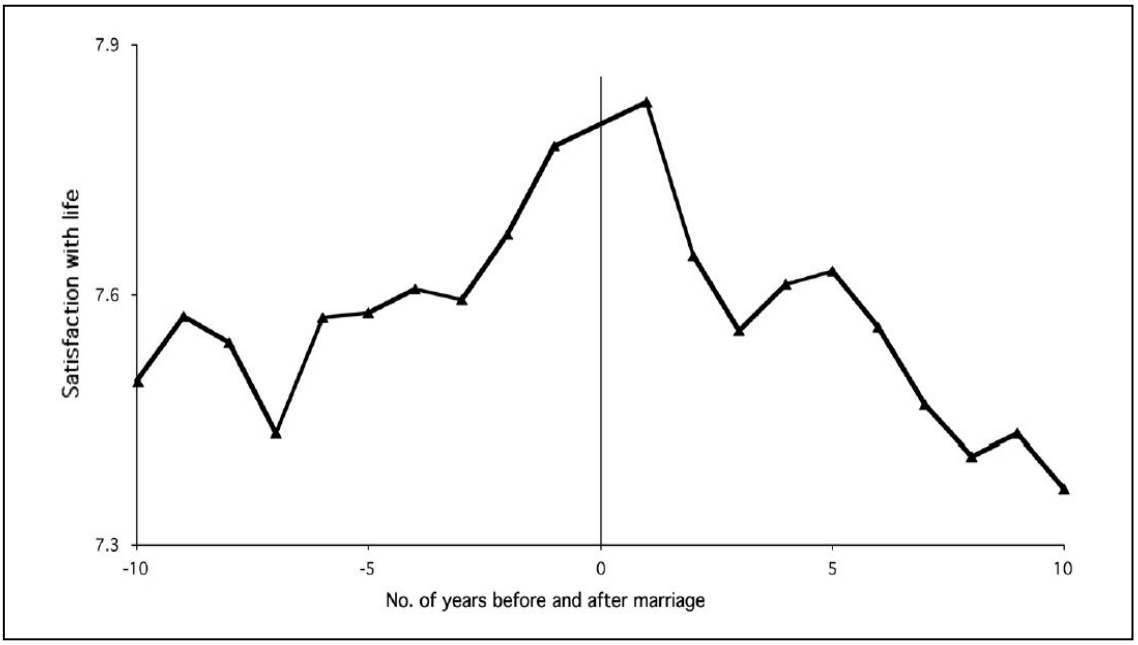

Figure 4

The pattern is obvious. As individuals came closer to their marriage, they reported a greater satisfaction with life because of the fact that their hope gave them happiness. Soon after marriage, their hope continued to build giving them more happiness. But finally as time passed, their experiences were definitely not matched with their level of hope, thereby resulting in a reduction in their reported satisfaction with life. A very interesting aspect of this study is that the graph is not symmetrical about the vertical line in the middle. Individuals were much less overall satisfied with their lives 10 years after marriage as they were 10 years before their marriage. This further supports the analysis done in this paper that happiness is not as prevalent as sadness. In other words, roughly speaking, sadness

is more natural than happiness and happiness requires efforts because happiness is related to the better life satisfaction and living standards, both of which are difficult tasks to accomplish.

In the same paper by Frey and Stutzer ([7]), another study was conducted where the question posed was whether happy people tend to marry more or marriage makes people happier? It was hypothesized that happy people tend to self-select themselves into marriage. The study showed that those people who are still single at a higher age (roughly 30), mostly those individuals are happier than others who are expected to be married. Another result of this study was that those people who self-select themselves into marriage are actually happier when they do so at an early age or at late age, the state of reported happiness being roughly the same in both cases.

Finally looking from a point of view of neuroscience, a consistent picture emerges just like in the case of sadness. The feeling of happiness indeed emerges from a sense of hope for pleasure while that of sadness emerges from the feeling of fear of displeasure, as noted above. In a detailed study conducted by Wilson-Mendenhall et. al ([8]) which was explained above, the same set of participants were asked to report their levels of hope for pleasure along with the fear of displeasure. The researchers found that brain activities in *orbitofrontal cortex* increased whenever the feelings of hope and happiness among other feelings (but interestingly not including fear and sadness among others). Orbitofrontal cortex is the region of brain that is mostly associated with reward and value. Hence as noted above, this is a clear evidence of *separateness/independence* of the feeling of fear from the feeling of hope (accordingly the *separateness/independence* of feeling of sadness from feeling of happiness) as expected and argued in this paper under a "fundamental" classification of emotions.

5. On Sadness and Happiness

Both of these feelings are universal in nature and require experience to feel them, as noted in this paper. They are very complex feelings arising out of complex biological machinery and psychological states. Indeed, both are inseparable from any individual. The fundamental feelings on which they are based are that of fear and hope respectively. The emotions of fear and hope are also inseparable from any individual and discussion of an individual without consideration of these feelings is definitely far from complete. Further, fear and hope among other fundamental feelings are based in intuition and do not require any kind of experience to face it. On the face value of it, these fundamental emotions can be felt even without the involvement of System 2 (slow and reasoned part of thinking) of our brain. Despite of the independence of fear and hope (accordingly, sadness and happiness respectively) from each other, there are certain links that need to be highlighted. In this section, both of these feelings will be discussed in a unified way.

It is clear from the preceding discussions that most of our choices and decisions are guided by fear of loss than hope for gain. This fact is beautifully captured in figure 1 and has been highlighted at many relevant places in this paper. The more steepness of the curve in figure 1 in the "loss region" than in the "gain region" shows that individuals tend to assign greater psychological values to losses than to gains. Accordingly, most of their choices are guided by their loss aversion tendencies. Further as pointed out in section II of this paper, individuals are not tuned to think statistically or in probabilistic terms. They are tuned to think in terms of losses and gains and assign psychological values accordingly. Since fear leads to sadness among other feelings like pessimism, depression etc. (as discussed in section III in this paper), hope leads to happiness among other feelings like confidence, overconfidence etc. (as discussed in section IV in this paper) and decisions are influenced in a more profound way by fear of loss than by hope of gain, hence sadness is more natural than happiness. By natural, it is meant that the general tendency is to be guided by fears and not hopes which in the long run lead to more sadness than happiness. This also means that happiness is often more tough to be achieved as argued above in this paper. It requires more confidence to take decisions guided by hope than by fear that will eventually lead to happiness if those hopes are realized. But confidence and risk seeking are themselves consequences of hope. So this makes it a circle, further emphasizing the toughness to achieve happiness over sadness. All these discussions are equally true for other feelings that are consequences of the emotions of hope and fear.

Most individuals tend to think intuitively that sadness and happiness are bipolar in nature, meaning exactly opposite of each other. But a careful discussion here will show that this is not the case. These two feelings are definitely not one-dimensional but actually, two-dimensional in psychological space. Since happiness stems from hope and sadness from fear but fear is not the bipolar of hope (despair is its bipolar), hence accordingly happiness cannot be bipolar of sadness. This follows from the basic rules of philosophical logic that if A stems from B and C stems from D and B and D are bipolar, then A and C will be bipolar too. The negation of the last statement is what is happening in this paper. Since negation of a true statement is still true by laws of logic, hence what follows is against the intuitive feeling of bipolarity of happiness and sadness. This analysis is supported by a study done by Rafaeli and Revelle ([11]) where they conduct various experiments. In one of their studies, they found that "changes in happy and sad moods are not always reciprocal." This completely supports the analysis done in this paragraph. In a different study which they illustrated in the same paper [11], they found that "rather than bipolar opposites, happy and sad reflect separable but not independent constructs." This also goes with the analysis above about separateness of fear and hope, thus sadness and happiness, along with the fact that happy and sad feelings are not bipolar. For this study, Rafaeli and Revelle ([11]) used 3,894 real participants and thousands of stimulated ones. They also showed in their beautifully argued paper that there are serious "pitfalls" of accepting happiness and sadness as one-dimensional "solutions". This supports the analysis above in this paragraph that happiness and sadness must be seen as two-dimensional features in the psychological space, that they are not bipolar contrary to intuitive understanding.

The independence of fear and hope is by far very much illustrated in this paper. Even considering a neuroscientific viewpoint, this has been illustrated that different regions of brain control feelings of fear, sadness, etc. on one hand and hope, happiness, etc. on the other hand. Amygdala controls the former while orbit frontal cortex controls the latter ([8]). This separability of happiness and sadness may seem counter intuitive but a careful examination shows that indeed, this is how it is. Barrett and Russell ([12]) actually discuss in their work about measures, which may prove helpful for researchers in affect measurement, that will lead to precise and comprehensive

information about such emotions and at the same time will take care of important findings like that of separability of sadness and happiness.

A natural question that arises is that what are the links between sadness and happiness? Indeed, they both exist simultaneously in any individual at any given moment of time and are dependent on the context in question. The solution of this question lies in the analysis of the consequences of fear and hope.

Case A: Starting from hope, an individual becomes happy when that hope is realized in the experience of that individual. As discussed above in this paper, happiness leads to confidence and makes an individual more a risk seeker but prolonged happiness is maladaptive because it leads to overconfidence which seriously hinders the ability to perceive risks appropriately and take informed decisions accordingly. This overconfidence leads to decisions in favor of those risks where risks are not even properly perceived and probability of actually "winning" (meaning depends on the context)is actually very low. Hence such decisions inevitably lead to losses in most cases. This causes the fear of loss realized in the experience of that individual. Now this chain reaction starts from fear and sadness takes the place of prolonged happiness from where the individual had started. Hence this provides a link that leads from happiness to sadness.

Case B: If an individual starts by basing a decision more influenced by the fear of loss than hope for gain (which is more natural and is contrary to the assumption considered in case A), then that decision is bound to be loss aversion by nature. So in the very first place, the individual will be risk averse and will never be willing to take risk and will always be willing to opt for settlements offered in place of taking risks. In the long run, some of the fears will be realized in the individual's experience. Even if not realized, the prolonged exposure to fear (which is always there) will have similar results. This will lead to sadness. Since there are very less chances that the decision will be made against the loss aversion and in favor of taking risks, hence chances are improbable that in this case, the individual will land to happiness from sadness. This confirms the fact that happiness are actually tougher to achieve than sadness which is more natural. Natural also in this sense that the starting condition in this paragraph is that of basing a decision more influenced by the fear of loss than hope for gain which happens to be more natural for majority of individuals. So the case considered in this paragraph is more pragmatic in nature than the case considered in the last paragraph.

But even if it is assumed that the decision is made against some odds in favor of taking risks and if *luck* (which actually plays a more dominant role in daily life than assumed by individuals because humans have evolved to think of everything in terms of cause and effect, with a pre-assumption that there must be a reason or meaning behind every event and this biasness to causality makes individuals to give luck lesser preference than it deserves) favors the individual (after all, luck boils down to *choices* made) and that individual "wins" the risk, then there comes hope and the individual may find landing to happiness from sadness. But the starting assumption of this paragraph itself shows that this assumption belongs to case A rather than case B. So this reverse process of landing to happiness from sadness is very unlikely. Hence case A shows that a person can actually land to sadness from happiness but case B shows that the reverse is improbable.

It is not possible to conclude the discussions on sadness and happiness without commenting on the intensity of these feelings. As illustrated in this paper, both of these feelings are dependent on the experience of the individual who is experiencing it. Now this experience can have severe impact or a minor one is completely subjective. Many "minor" hopes and fears keep on realizing in one's experience in daily life. A caution here is that use of such comparative adjectives like "minor", "major", "small", "large", etc. in contexts of emotions are highly subjective and meaning vary widely from one individual to another, one place to another and indeed, one time to another. As one of the firm examples to illustrate this point, people from the USA perceive anger to be a comparatively good and empowering emotion when compared with fear but people belonging to peaceful Machiguenga Indians in the Peruvian Amazon consider quite the opposite and regard fear as a better emotion over anger with a tendency to avoid anger at all costs (see footnote 11 on page 156 of [6]). Returning to the question of intensity and taking the liberty to use the word "minor" (along with other such adjectives) somewhat loosely for the sake of conveying the point, "small" gestures lead to fulfillment of "minor" hopes and fears. For example, while talking humbly to others with "proper" etiquettes and manners leads to realization of their hope for self-respect and leads to happiness. Similarly, talking rudely or in an "unacceptable" manner with respect to the person involved leads to realization of fear of embarrassment and leads to sadness and sometimes anger. All these are, of course, in addition to "major" events that severely cause sadness or lead to immense happiness. Hence, *"small" gestures* need to be considered one of the important criteria in day to day lives that tend to play a far more dominant role than are perceived to be.

6. Summary

In this paper, a new way of characterization of human emotions is proposed. This is done by dividing the entire lot of emotions in a set of "fundamental" emotions from which rest of the emotions are consequences. "Fundamental" means that those emotions are the building blocks and must satisfy certain criteria that tend to follow from the scientific definition of "fundamental". Namely, those emotions must be independent and the issue of separability, however counterintuitive it seems, must hold. Further they are, of course, not derivatives from other emotions. And they must be natural and universal without the requisite of experience to feel them. System 1 (fast and intuitive aspect of thinking) is sufficient to feel such "fundamental" emotions. In this paper, only the fundamental emotions of fear and hope are stressed because of the purpose of the paper that is to explore the origins of sadness and happiness. But, of course, this way of characterization must hold in general and can be applied to other emotions too. Finally, it must be pointed out that under this scheme of "fundamental" characterization of emotions, a holistic approach becomes inevitable as much as can be ensured because the independence of emotions need to be ensured from all perspectives and all spheres of knowledge.

Origins of sadness and happiness were explored in this paper and were found out that both of these emotions are not fundamental but derived from other fundamental emotions of fear and hope respectively. The fear (of loss, of pain, of death, of suffering, of displeasure, etc.) and hope (for gain, for cooperation in a coalition, for pleasure, for survival, etc.) form the basis of sadness and happiness respectively. It was illustrated in this paper that the question of their separability is also supported by neuroscientific viewpoint where amygdala and orbit frontal cortex – two different regions of brain –are responsible for the former and the latter respectively. "Fear" causes sadness (upon realization of fear in the individual's experience) which in turn can lead to depression over prolonged experience and pessimism. These are heavily pronounced in decision making capabilities of individuals where they tend to become more of risk averse. Further it was illustrated in this paper that "hope" leads to happiness (upon realization of fear in the individual's experience) which in turn lead to confidence. But prolonged happiness, just like prolonged sadness, is maladaptive. It leads to overconfidence. Both confidence and overconfidence make an individual more of a risk seeker. But overconfidence tends to hamper the assessing of risks by undermining the fear of loss and hence result in landing over to sadness from happiness as explained in section V of this paper. But the reverse process is improbable to happen.

It was also showed in this paper that why and how is sadness more natural and why is happiness difficult to achieve? Happiness is adaptive evolutionary because it leads to a better standard of living which is a difficult job to attain. It was also showed that happiness and sadness are not bipolar as expected intuitively. The entire analyses done in this paper were supported by various studies done in many different places and times by various authors. As a concluding remark, it can be pointed out that this way of characterization can open a new scope to view and analyze various psychological states where taking a holistic view becomes inevitable to the maximum extent possible in the realm of possibility and that in turn leads to a better understanding and a comprehensive view.

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