Temporal Causal Network Model for Appraisal Process in Emotion

Fawad Taj and Michel C. A. Klein
Behavioural Informatics Group, VU University Amsterdam, The Netherlands

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Abstract: Most of the emotion theories consider appraisal as the major component in an emotional episode. The appraisal theories legitimately try to explain the actual process of appraisal. Number of computational architecture for emotional and cognitive agents exists, which try to incorporate the major cognitive appraisal theories, but they compromise on a certain aspect of the theories due to its complexity. In this paper, a temporal causal network model approach is used to address the dynamics and temporal processing of different evaluation checks in the appraisal component. The checks included in the model are inspired by the Component Process Model and other neuro and cognitive science literature. Simulations have been done to show the temporal causality between different evaluation checks.

1 INTRODUCTION

Appraisal theories of emotion define emotion as a process, not state (Moors et al., 2013). The term "appraisal" was first introduced by (Arnold, 1960) as a counter argument against William James (1884) famous bear example, where he claims that emotions are the reaction or interpretation of physical arousal, after stimulus onset. In contrast, Arnold claims that, before any emotional experience, human thoroughly evaluate the event/situation according to their well-being. So, these are those thoughts that make our perception and generate emotion. (Kemper and Lazarus, 1992) claim that "emotions are organized psycho-physiological reactions to news about on-going relationships with the environment." (Arnold, 1960), (Lazarus, 1966), (Kemper and Lazarus, 1992) (Moors et al., 2013), (Moors et al., 2013), (Frijda, 1986) and (Scherer, 1984) are the major adherents and formalizer of this type of theories. Appraisal theories consider emotion as a componential process because so many sub-systems work together to coordinate and synchronize the process.

Furthermore, a recent and well explained appraisal theory is proposed by (Scherer, 2001), who tries to answer all the major questions related to dynamic design feature of emotion through Component Process Model (CPM) (Scherer, 2001, 2004, 2009). The appraisal component in CPM has defined clear criteria or checks for the elicitation of the event, Scherer calls them as Stimulus Evaluation Checks (SEC's). In a recent version of CPM (Scherer, 2013) the SEC's are categorised into four major appraisal intents. The ordering and output of these SEC's are thoroughly explained and scientifically proved through numerous studies.

There are a number of computational models that used Scherer theory as the main component for cognitive appraisal processing within their models, e.g. WASABI (Becker-Asano, 2008), PEACTIDM (Marinier, 2008), etc. Most of the computational models ignore the causal and temporal dimension of CPM and are mostly designed as the rule-based systems (Sander, Grandjean and Scherer, 2005). Scherer proposed a network-based representation for the computational model in which one node represents single evaluation check (see Fig 1.). In parallel fashion and through some sort of appraisal derivation model, each node will always be updated through best estimated value about the event (Sander, Grandjean and Scherer, 2005). Moreover, he also suggest to adopt non liner dynamics system for emotional modelling rather than linear function or statistical methods (e.g. regression analysis) (Sander, Grandjean and Scherer, 2005).

The focus of this article is to design a temporal causal network model for appraisal component of emotion, mainly inspired by the CPM, whereas keeping the component view in mind, for computational appraisal model suggested in (Marsella et al., 2010) (see Fig 2.). This article uses CPM variables as a base for affect derivation with its intensity and its consequences on action preparation and execution. The temporal dimension and the

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causality between the checks have been critically analysed and simulated.

The paper is structured as follows. Section 2 consists of detail discussion about all the SEC's in appraisal component of CPM. Section 3 presents the temporal causal network modelling approach. In Section 4 the implementation of the computational model for appraisal is discussed. Section 5 describes simulations that illustrate the working of the model. Finally, Section 6 contains the conclusion.

2 THEORITICAL BACKGROUND

In the CPM architecture emotion is defined as "an episode of interrelating, synchronized changes in the states of all or most of the five organismic subsystems in response to the evaluation of an external or internal stimulus even as relevant to major concerns of the organism" (Sander, Grandjean and Scherer, 2005). So, from the definition, it can be concluded the storyline of emotion starts with the appraisal. Appraisal is, therefore considered as one of the major components of CPM.

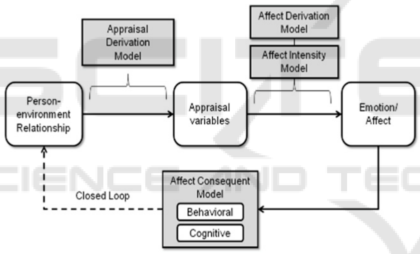

Figure 2: Component model view of computational appraisal models, adopted from (Marsella et al., 2010).

Recent studies of electrophotography (EEG) and event-related potentials (ERPs) on neural response of the brain to emotional events recorded this response within 200 ms after stimulus presentation (Hillyard, Teder-Sälejärvi and Münte, 1998). The earliest processing of emotional episode starts with cognitive appraisal, which ranges from detecting the novelty to more complex check of causality and evaluating coping potential (Folkman and Lazarus, 1985; Scherer, 2001). The responses from all the sub-systems are collectively labelled to certain emotion in the language spoken in the respective culture. The main components that uncover the whole emotional episode are; appraisal results, action tendencies, motor expression, somatovisceral changes and feeling component with subjective experience (Scherer, 2001, 2005, 2013). Some of the main issues that are still under discussion in appraisal theories are the number of appraisal criteria's and the ordering of the checks. In this paper only those checks are used for which we have found conclusive solid evidence for its validity and ordering from neuroscience, psychology or cognitive sciences literature.

2.1 CPM Variables

Stimulus Evaluation checks(SEC's), categorized in four groups (Relevance, Implication, Coping potential, Normative significance), listed in order of processing proposed in CPM architecture (Scherer, 2013).

2.1.1 Relevance

Almost all the appraisal theorist agree on the fact that the first evaluation check in the appraisal process is

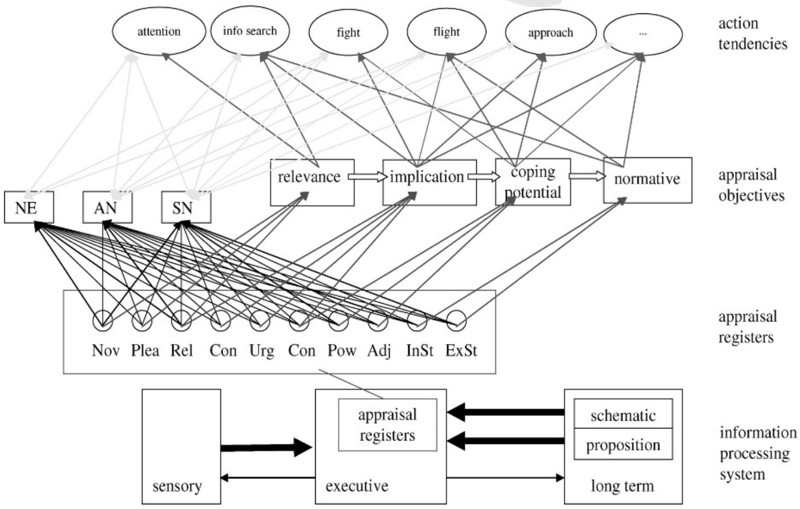

Figure 1: Architecture of appraisal process in CPM produced from (Scherer, 2005).

relevance. It is processed at very low unconscious level and at very automatic fashion, due to this property, some of the critics are against using this as an appraisal check. The stored schemata have been matched to event/stimulus features and if they match closely then attention is deployed.

In CPM the relevance detection has been further explored and it has been found that the following parameters determine the relevance of the event: *Novelty occurrence, Intrinsic pleasantness, Concern relevance.*

Novelty occurrence check: At this check the question is how familiar or sudden the event is? It is considered that novelty has been checked at sensory–motor level and it is considered as first step toward emotional episode. Different responses have been recorded in the peripheral cortex and hippocampus as soon as 100 ms after stimulus onset (Brown and Bashir, 2002) and an increased response to novel stimulus (Blackford et al., 2010).

Intrinsic pleasantness is the innate quality of an event/stimulus and mostly the processing of this check is free from appraiser motivational factors (current needs, goals, taste etc.), but some of the theorists define this check as concerned relevance of event, given all of his motivational factors. Some of the famous intrinsic un/pleasantness stimuli groups exists e.g evolutionary prepared (snake, anger, expression), reproduction (sex), taste(sweetness), etc (Scherer, 2013). At the end, most of the researchers agree with the fact that intrinsic pleasantness increases amygdala response and is recorded at 140 ms after stimulus onset (Pourtois et al., 2010).

Concern pertinence is the relevance check where current motivational factors matter. For example, less attention will be paid to food cues in a state of satiety (Sacharin, Sander and Scherer, 2012). So, the concern relevance covers a large array of motivational states. This is why it is the most complex part of relevance check.

2.1.2 Implication

To further process the relevant emotional stimulus, the next target is to find its consequences for one's well-being. The checks define Implication that are:

Goal Conduciveness checks the compatibility of the event with the current goal, i.e. whether the event is facilitating or blocking progress toward goal-attainment. The neuroscience literature shows that conflict processing during goal quest has been recorded in cingulate cortex (AAC) and dorsolateral prefrontal cortex (DLPFC) (Brosch and Sander, 2013). The activity of ACC has been detected at 340-380 ms after the conflicting stimulus onset (Van Overwalle, 2009).

Agency: The core theme of this check is to find causation of the event: caused by me, someone else or nature? Neurosciences research shows that different regions are involved in both internal and external agency (Sperduti et al., 2011).

Causal motive check tries to find the reason for stimulus. Why it happened and determines whether it is intentional or negligence.

Discrepancy from expectation, calculate the difference between the expectation and actual action at the point of time. So, the higher the difference, the higher the value will be.

Outcome probability checks the likelihood of the event in form of probability. This check is also important in calculating the intensity of the appraisal frame.

Urgency Check determines the strength of action when something important is on stake. In neuroscience perspective, its effect is an immediate increase in action in autonomic nervous system (ANS).

2.1.3 Coping Potential

An earlier appraisal model of (Folkman and Lazarus, 1985) used the term secondary appraisal, which finds the resource options available to deal with the current situation. Scherer in his CPM model discussed three further aspects of coping potential appraisal.

Control determines the coping potential by investigating how much control one has over the situation. For example, in a natural disaster one has very low control, whereas events can be controllable when humans are involved.

Power aspect of coping potential appraisal checks for physical strength, money social support, information etc.

Adjustment determines one's ability to accommodate the effect of an event.

2.1.4 Norm Significance

Humans live in society and have certain social norms due to which individuals are always curious about the views of others on certain actions. There are two further sub-aspects of normative significance.

Internal standard checks how much the action and outcome is compatible with one's internal standard and moral standards.

External standard checks how much the action and outcome are compatible with society norms and standards.

2.2 Affect Derivation Component

After detail discussion about all the checks for stimulation evaluation, now we move to the outcome of these variable as a whole and what should we expect out of the model. The feeling component within CPM has a very important role of monitoring and regulation of the component process model. Every component within CPM expresses its emotional experience through the feeling component and this state also serve the purpose of a communication link between the components. All information that becomes conscious in central representation state, is called "feeling" or qualia. The integrated information from all the components to feeling states determines its quality, intensity and duration (Scherer, 2001). Now a days, the only measure we have to count conscious feeling is through verbal self-report. Therefore, to accommodate this model into other emotional or cognitive agent architecture we propose a separate affect derivation block where we can find intensity and label of the current appraisal profile.

Moreover, some of the modeller calculated intensity of the appraisal profile and is used to map the appraisal profile to two or three-dimensional space. This intensity can be used to differentiate between number of close affective states, for example cold anger vs hot anger. We also calculated intensity which will be discussed in detail in section 4.

The feeling actually serves a kind of monitoring and helps in choosing the best possible options for an action. We tried to incorporate the feeling component suggested by (Damasio, 1998). In our model before performing an action, feeling state is affected by predictive as-if body loop, which give a sense of preview and valuing the action before it has actually been performed. This feeling state can be later used for emotion regulation and integration of other cognitive states.

3 TEMPORAL CAUSAL NETWORK MODELING

The temporal causal-network modelling approach explained in (Treur, 2016) has been used to model the proposed model. It is generic approach to model any dynamic process with causal relations. The temporal dimension enables the modelling of cyclic causal relations with exact timing. In broader terms, there are some similarities between artificial neural networks and this approach, for example in case of continuous time and recurrent, but there are important differences as well. For example, no hidden layer exists that do not represent any real-world phenomena; each state within this approach should be clearly defined with exact causal and temporal dimensions.

The models in temporal causal network modelling approach can be represented in two ways: a) conceptual representation and numerical represent-tation. Both types of representation can be easily transformed into each other in a systematic manner.

Conceptual representation can be done through graphs or matrices. A graphical representation involves states which represent some real wold phenomena and the arrows show the causal relation between the two states. Some additional information is given below:

- Value of connection(ωX,Y) representing strength of causality and it value ranges between [-1, 1].
- How fast a state Y can change upon casual impact. Speed factor is denoted by ηY, and value ranges between [0,1].
- For multiple impacts on state Y, combination function cY(...) is used to combine the effect.

There are a number of combination functions defined, varying from simple sum function to advance logistics function.

The conceptual representation of model can be translated into numerical representation as follow.

- For any state Y at any time point *t*, Y(t) denots the activation value of **Y**.
- The causal impact of state **X** on **Y** at time point t, can be defined by

  $$\text{Impact}_{X,Y} = \omega_{X,Y}\, \mathbf{X}(t).$$

- Total aggregated impact of the multiple impact on state Y at time t combined by combination function cY(...) can be defined by

  $$\mathbf{aggimpact}_Y(t) = \mathbf{c}_Y(\mathbf{impact}_{X_1,Y}, \mathbf{impact}_{X_2,Y}, \mathbf{impact}_{X_3,Y}, \ldots)$$
  $$= \mathbf{c}_Y(\omega_{X_1,Y} X_1(t), \omega_{X_2,Y} X_2(t), \omega_{X_3,Y} X_3(t), \ldots)$$

  the $\mathbf{aggimpact}_Y(t)$ will have upward or downward effect at time point t, but how fast this change takes place depends on the speed factor η_Y,
- $Y(t+\Delta t) = Y(t) + \eta_Y\, [\mathbf{aggimpact}_Y(t) - Y(t)]\, \Delta t$
- The following difference and differential equation can be obtained for state **Y:**

  $$Y(t+\Delta t) = Y(t) + \eta_Y\, [\mathbf{c}_Y(\omega_{X_1,Y} X_1(t), \omega_{X_2,Y} X_2(t), \omega_{X_3,Y} X_3(t), \ldots) - Y(t)]\Delta t$$
  $$dY(t)/dt = \eta_Y\, [\mathbf{c}_Y(\omega_{X_1,Y} X_1(t), \omega_{X_2,Y} X_2(t), \omega_{X_3,Y} X_3(t), \ldots) - Y(t)]$$

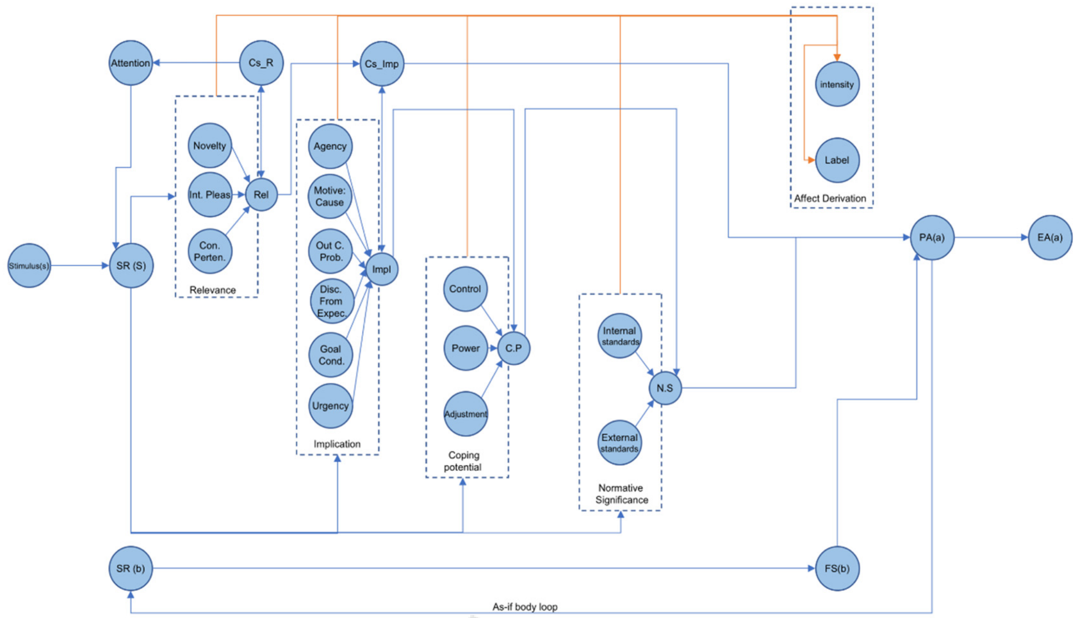

Figure 3: The graphical conceptual representation of proposed model. Circles represent the states and arrows show the connections. The orange arrows are used to calculate the intensity. Abbreviations: SR(s), sensory representation of stimulus; Rel, *Relevance*; Impl, *Implication*; C.P, *coping potential*; N.S, *normative significance*; PA(a), *Preparation for action* (a); SR(b), *sensory representation* of *bodily state*(b); FS(b), *Feeling for action*; EA(a), *Execution* of *Action*(a).

4 THE COMPUTATIONAL MODEL

The proposed model is designed at the conceptual level, keeping in mind the temporal and causal attributes of CPM and also the component view of computational model from Marsella (see Fig. 2). The insights are already discussed in Section 2. In most of the architectures the appraisal variables derivation and affect derivation process are separated. We mainly focused on affect derivation and its effect on action selection.

4.1 Graphical Representation of the Model

An overview of the model is depicted in Figure 3. It shows the conceptual representation of the temporal causal model of the cognitive appraisal process. The parameter defining each checks are separately marked in doted box, e.g. for relevance check is defined by novelty, intrinsic pleasantness, concern relevance. The other checks in second third and fourth place are implication, coping potential and normative significance respectively. Scherer theory claims that the order of causality is caused by economical and logical reasons and argue that it is uneconomical to process the stimulus if it is not relevant. He further argues that once the stimulus is considered relevant, the attention has been developed toward the stimulus and further checks have been performed. This casualty has been adopted in the model by applying advance logistic function in which a certain threshold can be defined, if the values goes above that threshold then further checks would be performed.

Furthermore, Control state has been used which check the value of the relevance, once it get high from a given threshold, it would activate the effecting states for example in our model when relevance is high, control state for relevance will activate attention. The other control state is used for implication check which also activate action state.

There is a causality between appraisal and action formation which has been modelled by combining Damasio's as-if body loop (Damasio, 1999). Damasio argues that before taking any action there is an internal simulation of the action prior to the actual action. This simulation is then compared with the feeling associated with each option available and gives a sort of action selection process, a GO signal. The as-if body loop conceptually looks like:
Sensoryreprsentation(Srs)→
preparationbodilychanges(PA(b))→ActionExecution (EA(a))

4.2 Formalization of the Parameters

Valence is considered as simple continuous one-dimensional value e.g. bad vs good, tall vs. short, positive vs. negative etc.). Whereas, in CPM and many other appraisal models different type of valence appraisals are used for example intrinsic pleasantness vs intrinsic unpleasantness and goal conduciveness vs. goal obstructiveness. For this model, we have scaled all the type of valence appraisal to the values, ranges between [-1,0]. The range of scaled values are: Novelty [0,1], Intrinsic Pleasantness [-1,1], Concern Pertinence [0,1], Goal Conduciveness [-1,1], Agency [0,0.5,1], Causal Motive [0, 0.5, 1], Outcome probability [0,1], Discrepancy from Expectation (DE) [0,1], Urgency [0,1], Control [0, 1], Power [0,1], Adjustment [0,1]

The combination function, initial value and speed factor for each state is given in Table 1, whereas Table 2 defines connection between states.

Table 1: Initial values, Sped factor and combination function used in model.

States	Initial value	Speed factor	Combination function
Stimulus(s)	0	0.3	Identity
Sr(s)	0	0.3	Alogistic with σ=30 τ=0.3
Novelty	1	0.4	Identity
Int. Pleas.	1	0.4	identity
Con. Perten.	1	0.4	Identity
Rel	0	0.4	Alogistic with σ=30 τ=0.3
Attention	0	0.4	Identity
Cs_R	0	0.3	Alogistic with σ=8 τ=0.3
Agency	0.9	0.4	Identity
Cause Motive	0.9	0.4	Identity
Out C. Prob.	0.9	0.4	Identity
Disc. From Expec	0.9	0.4	Identity
Goal Cond.	0.9	0.4	Identity
Urgency	0.9	0.4	Identity
Imp	0	0.3	Alogistic with σ=0.4 τ=0.4
Cs_Imp	0	0.3	Alogistic with σ=5.5 τ=0.2
Control	0.9	0.3	Identity
Power	0.9	0.3	Identity
Adjustment	0.9	0.3	Identity
CP	0	0.3	Alogistic with σ=0.5 τ=0.4
Internal standard	0.9	0.3	Identity
External Standard	0.9	0.3	Identity
NS	0	0.3	Alogistic with σ=0.5 τ=0.3
PA(a)	0	0.2	Alogistic with σ=0.7 τ=0.2
SR(b)	0	0.2	Identity
FS(b)	0	0.2	Identity
EA(a)	0	0.09	Alogistic with σ=20 τ=0.3

Table 2: Connection values between states.

From	To (connection value(s))
Sr(s)	All the connection value from **Sr(s)** to other states is 0.9.
Novelty, Int Pleas, conc. Pert.	**Rel**(1,0.7,0.5)
Agency, Cause Motive, Out C. Prob, Disc From Expec, Goal Cond, Urgency	Connection value is same for all these connections, **Impl**(1).
Control, Power, adjustment	Connection value For all these connection to **C.P** value is 1.
Internal standard, external standard	**N.S**(1)
Rel	**Cs_R**(1)
Cs_Rel	**Rel**(-0.15), **Attention**(1)
Attention	**Sr(s)**(0.5)
Impl	**Cs_Impl**(1), **C.P**(1)
Cs_Impl	**Imp**(-0.15), **PA(a)**(1)
C.P	**N.S**(1)
N.S	**PA**(0.4)
PA(a)	**Sr(b)**(1),**EA(a)**(1)
Sr(b)	**FS(b)**(1)
FS(b)	**PA(a)**(1)

4.3 Affect Derivations

As discussed in section 2, the affect derivation is the key component in any appraisal model. In affect derivation process, we are calculating Intensity and would label the appraisal profile that is currently under consideration.

4.3.1 Intensity

One of the important aspects which determines the effect of appraisal on behaviour is intensity. It is also important for mapping appraisal into a multidimensional space. Currently there are no standard theories or rules for producing intensity but (Marinier, Laird and Lewis, 2009) defined three general criteria for an intensity function:

1. Intensity should in limited range of [0,1].
2. Value of intensity should not be influenced by single appraisal value, each appraisal check should contribute
3. The value of intensity for expected stimulus should be less than unexpected one.

Keeping in mind all the above conditions, the function that will calculate the intensity is the combination of *Outcome probability*(OP) and

Discrepancy from expectation (DE). If both OP and DE are low or high, intensity will be high because either check doesn't meet, if they are having opposite values then intensity would be low. They call it a surprise factor:

$$I = (1 - OP)(1 - DE) + (OP.\,DE) \ldots \quad (1)$$

To include other checks and to meet first and second conditions above, normalized values of the checks having range between [-1,1] are used, the overall equation comes out like:

$$I = [(1 - \mathrm{OP})(1 - \mathrm{DE}) + (\mathrm{OP}.\mathrm{DE})].[\,\mathrm{Nvl} + \frac{|\mathrm{IP}|}{2} + \mathrm{CP} + \frac{|\mathrm{GC}|}{2} + \mathrm{CTRL} + \mathrm{PWR} + \mathrm{ADJ} + \mathrm{IntS} + \mathrm{ES}]/\mathrm{num\_dimen's} \quad (2)$$

4.3.2 Appraisal Profile and Emotion Label

In appraisal theories, it is usually assumed that there is no direct relation between situation and specific emotion. But somehow few of the appraisal theorists manage to show the appraisal profile regarding some basic emotions e.g. (Nezlek *et al.*, 2008). Animate organism have this evolutionary adaption process which produce frequently recurring patterns of environmental evaluation, which Scherer (1984, 1994) called as modal emotions. These modal emotions result from specific SEC outcome, are labelled in a single word according to certain social and cultural similarities

The results of the appraisal process will not only determine the type of emotion or blend of emotions but also the intensity. So, the verbal reporting of the feeling relies on language and the certain emotion categories through different pragmatic devices cannot produce the whole story. We can calculate the label by using any classification technique for example we can find the Manhattan distance or K-Mean clustering algorithm to find the nearest modal emotion to the appraisal profile, this part will be done in future wok. Furthermore, CPM assumes emotion in continues space of emotion as opposite to categorical emotions (e.g happy, sad, disgust etc.). Scherer also provided mapping between appraisal profile and emotion labels, he called it as *modal emotions* .

5 SIMULATION AND RESULTS

A number of simulations are performed to prove the below mentioned hypotheses.

H1: If the relevance is high then attention will be devoted toward stimulus and the rest of the checks will be processed.

H2: All the checks will be executed sequentially according to CPM model. The order will be relevance, implication, coping potential and normative significance.

H3: If the relevance value is low no other check will be processed.

H4: when Implication is low, lower activity is shown at action preparation state.

H5: Low coping potential and normative significance do not disturb the causality among the appraisal checks and has not much effect on action preparation.

Every simulation is performed for 120 time steps with Δt=0.1. The initial value of the check defines the valance or strength of the check.

Table 3: States initial values for hypotheses 1 to 5.

Criterion	H1/H2	H3	H4	H5
Relevance				
Novelty	1	0.1	1	1
Intrinsic Pleasantness	1	0.1	1	1
Concern Pertinence	1	0.1	1	1
Implication				
Agency	1	1	0	1
Cause Motive	1	1	0	1
Outcome Probability	0.9	0.9	0	0.9
Discrepancy from Expectation	0.9	0.9	0	0.9
Conduciveness	0.9	0.9	-1	0.9
Urgency	0.9	0.9	0	0.9
Coping Potential				
Control	0.9	0.9	0.9	0
Power	0.9	0.9	0.9	0
Adjustment	0.9	0.9	0.9	0
Normative Significance				
Internal Standards	0.9	0.9	0.9	0
External Standards	0.9	0.9	0.9	0

5.1 H1: High Relevance

The following values have been used as initial values to determine the high relevance (see Table 3). Note that all the other values are also kept high to show the impact of control state. The control state acts a monitoring and regulatory state which is used to monitor the value of relevance.

The Fig. 4(a) shows the simulation with high novelty, intrinsic pleasantness and concern pertinence values, which in turns define high relevance. The simulation clearly shows that the relevance(red line) is high at the start, but it takes a while to activate attention (yellow). Once the attention is developed it start processing the current stimulus, that's why the sensory representation state (dark blue) value starts increasing after attention development. All the other values checks are also so high but they are not processed until the relevance get high.

5.2 H2: Ordering between Checks

The most important point is that the values of all the checks are not processed until and unless the sensory state value gets high and there is also the casualty ordering among the checks; Relevance, Implication, Comping potential, normative significance. In Fig. 4(a) it can be seen that there is so high values for all the states at start of the simulation, but the casualty between the states are intact.

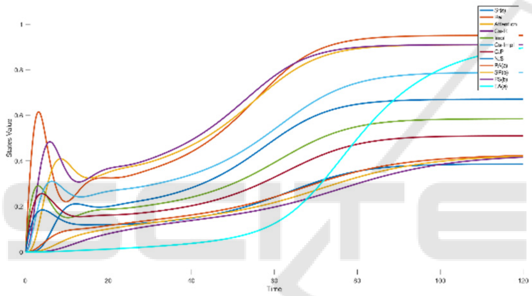

Figure 4(a): The simulation of model with parameter for hypotheses H1 and H2.

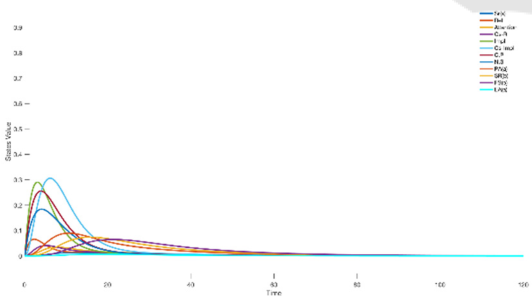

Figure 4(b): The simulation of model with parameter for hypotheses H3.

5.3 H3: Low Relevance

To prove third hypotheses, we assigned very low values to relevance checks and left other values unchanged. The Fig. 4(b) shows that no states value is executed because the relevance is so low and according to Scherer it's illogical and un economical to process further state, if relevance is low.

5.4 H4: Low Implication

Implication check plays an important role in behaviour preparation after any stimulus onset. According to Scherer, any action taken is depended initially on the value of implication appraisal check. For higher value of implication in Fig 4(a) you can see the preparation of action state get higher when the value of implication get higher but with low value it gets down. Simulation of low implication with values given in Table 3 is shown in fig.5.

5.5 H5: Low Coping Potential and Normative Significance

The sequence assumption, made in CPM is still valid even when the coping potential and normative significance gets low. The lower coping potential value delay the process of normative significance. The effect of coping potential and normative significance on action preparation has not been discussed in detail in CPM model, but the ordering and the causality of the checks are elaborated. These ordering can be seen in the fig. 6 below, which still intact what's so ever the values are. The values of the state's defining coping potential and normative significance are set to zero.

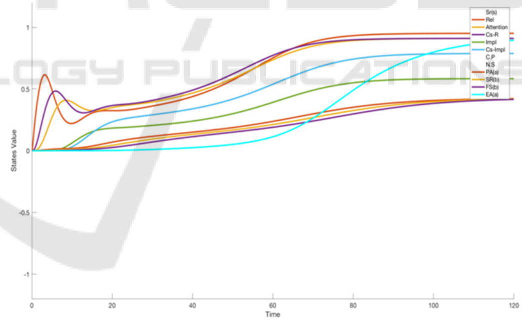

Figure 5: The low implication value lowers the action preparation state. Some line are made invisible to see the clear effect.

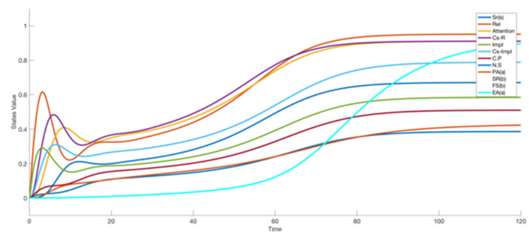

Figure 6: The low coping potential and normative significance keep casualty ordering intact. Some line are made invisible to see the clear effect.

5.6 Intensity

For differentiation between different affective states or distinguishing mood and emotion, Intensity plays an important role. Fig. 4 show the intensity for both the appraisal profile defined in Table 3. These intensities are calculated based on equation given at section 4.3.1

Table 4: States initial values for hypotheses 1,2,3,4 & 5.

	H1/H2	H3	H4	H5
Intensity	0.3918	0.1640	0.3918	0.2460

6 CONCLUSIONS

In this paper, a temporal causal network model has been presented, which simulates the dynamics and causality claimed in *component process model* of appraisal by Scherer. This computational model is designed in such away that, it can be embedded in any cognitive or emotional architectures for agents. The simulation clearly represents the causal relation between the evaluation checks, high relevance of the stimulus will leads to further processing of stimulus. The high implication value will activate behaviour responses state. The Damasio feeling for action has been embedded which can be used for emotion regulation in future. The intensity graph is separately represented because it is not calculated over time. The label states can be assigned to the given appraisal profile by simple classification techniques.

In future, we will try some of emotion regulation techniques proposed by (Gross, 1998), through cognitive reappraisal. The feeling state will be used to control the different emotion regulation strategies.

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