Example 2 – Astronaut Delegates a task to the Robot:

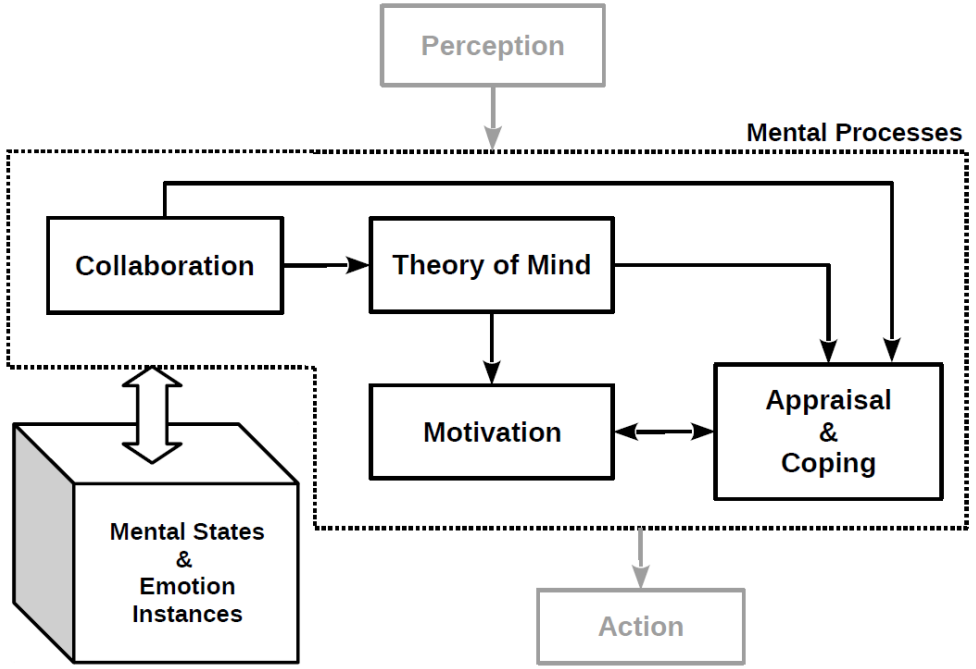
Emotion-awareness	Emotion-Ignorance (neutral)
A1. Astronaut: *I still have some problems with attaching the first panel! We do not have enough time. You should begin to install the second panel.* *[Astronaut is worried.]*	***B1. Astronaut:*** *I still have some problems with attaching the first panel! We do not have enough time. You should begin to install the second panel.* *[Astronaut is worried.]*
A2. Robot: *Okay. Don't worry. I can handle that.* *[Robot perceives Astronaut's worriedness and acknowledges that. Also, it doesn't ask the Astronaut (because of perceiving worriedness) if it is okay to leave the current task which was helping the Astronaut to install the first panel.]* *[Robot perceives the Astronaut's request as on "open planning" (as oppose to specific executive) task delegation.]*	***B2. Robot:*** *Okay. I can handle that. Is it okay if I leave the current task though?* *[Robot does not perceive Astronaut's worriedness.]* *[Robot perceives the Astronaut's request as on "open planning" (as oppose to specific executive) task delegation.]*
A3. Astronaut: *I will try to fix it asap.* *[Astronaut's is still worried.]*	***B3. Astronaut:*** *Yes, that's fine. I can finish it by my own.* *[Astronaut is still worried.]*
A4. Robot: *I might need to ask some questions while I am installing the second panel.* *[Robot perceives Astronaut's worriedness]* *[Robot checks a) dependencies of the task (a sub-task might need to be done by both parties), b) preconditions, c) required resources, d) possible future conflicts.]* *[Robot needs to ask several questions to remove uncertainties, but because of the Astronaut's emotion, Robot decided to postpone questions about the details to when the Astronaut's answers are necessary to make progress. Robot modifies its utterance in a proper way.]*	***B4. Robot:*** *Okay. But according to the plan, I need your help when we need to weld the panel. Will you be able to help me?* *[Robot does not perceive Astronaut's worriedness.]* *[Robot checks a) dependencies of the task (a sub-task might need to be done by both parties), b) preconditions, c) required resources, d) possible future conflicts.]* *[Robot needs to ask several questions to remove uncertainties, so it does, since it misses the Astronaut's negative emotion.]*
A5. Astronaut: *That's fine. Just let me know.* *[Astronaut is neutral.]* *[Robot perceives Astronaut's neutral (more positive) emotion, and mission continues.]*	***B5. Astronaut:*** *Yes, I will.* *[Astronaut is more worried about finishing the first panel.]* ***B6. Robot:*** *We also need your welding tool and supplies as well as the measuring tool to install the second panel.* *[Robot does not perceive Astronaut's worriedness. So, it continues to ask question.]* ***B7. Astronaut:*** *Just let me know whenever you need something!* *[Astronaut becomes frustrated, since he thinks the Robot's questions are killing time.]* ***B8. Robot:*** *Thanks. I will. How about the conflict that might occur while I am trying to fix the second panel? You are going to need my help at the same time. Last time this issue terminated our mission.* *[Not only the Robot does not perceive Astronaut's frustration, but also asks about some possible future problems based on* ***reflection*** *of the same tasks in the past.]*

	B9. Astronaut: *Robot, I really don't understand what you are talking about!* *[Astronaut becomes more frustrated.]* ***B10. Robot:*** *Do you want me to provide some examples?* *[Robot does not perceive Astronaut's strong frustration. So, it doesn't stop asking questions.]* ***B11. Astronaut:*** *We don't have time for this anymore!* *[Astronaut becomes angry.]* *[Mission continues after a prolonged communication, while the Astronaut's collaborative plan is disrupted.]*

NOTE: This example shows how delegation critically depends on understanding how worried the other collaborator is and the necessity of having sufficient time, which play together. The emotion-ignorant robot is doing planning in its most efficient manner (efficient because time is short): asking a lot of questions (i.e., B2, B4, B6, B8, B10) so that it can work out the plan. But asking questions exacerbates the Astronaut's worry, whereas when the robot knows about the Astronaut's worriedness, it can use its own motivation mechanism to come up with a way to alleviate that. Its methods are to exactly postpone any questions until such time as they are critical (i.e., A2, A4).

Emotions [A, V, S]:
Worriedness = [0.5, -0.5, -0.5]
Frustration = [-0.5, -0.5, 0.1]
Anger = [0.7,-0.5,0.6]
Neutral = [0, 0, 0]

NOTE: I use a convention to refer to the utterances of the left column (in the first page) by A# and the right one by B# in my walk-through explanations.



Self-Synchronization: Represents the relationship of the self with the environment. It is having a policy to increase sense of shared awareness. Shared awareness is the ratio of required task information shared between the collaborators to the task information yet need to be resolved.

If Robot perceives Astronaut's **frustration** correctly: (Worriedness = [0.5, -0.5, -0.5])

1. **(Perception)**: Robot perceives human's utterances and emotion. **(A1)**

2. **(Collaboration , Theory of Mind → Reverse Appraisal):** Robot uses *reverse appraisal* to understand the meaning of *worriedness* according to the *collaborative task status* (e.g., precondition status, postcondition status, required resources, shared goal). Robot updates human's *user model* respectively.

3. (**Appraisal**): Robot *appraises* Astronaut's utterances and emotion.

4. (**Collaboration , Motivation → Motive Formation → Belief Formation → Intention Formation**): Robot forms new motives according to the Astronaut's request, and the result of a) *appraisal* with respect to the *shared goal*, and b) *reverse appraisal* of the human emotion. Robot forms new beliefs about a) status of the current tasks, and b) the new given task. Robot forms new intention(s) with respect to the new beliefs.

5. **(Mental States, Coping)**: Based on the current mental states, Robot chooses an *emotion-focused* coping strategy and decides to acknowledge Astronaut's emotion, and provide a proper response. **(A2)**

** Robot perceives human's new utterance and emotion, just as above procedure. **(A3)**

6. **(Collaboration, Belief Formation → Intention Formation , Mental States)**: Robot uses the collaboration plan and recipe to extract task constraints (e.g., responsibilities, preconditions, required resources). Robot forms new beliefs and intentions about missing information.

7. **(Mental States, Coping)**: Robot chooses a proper utterance about missing information according to human's emotion. **(A4)**

** Robot perceives human's new utterance and emotion, just as above procedure. **(A5)**

If Robot **does not** perceive Astronaut's emotions: (Neutral = [0, 0, 0])

1. **(Perception)**: Robot only **perceives** human's utterances. **(B1)**

2. **(Collaboration , Theory of Mind → Reverse Appraisal):** Robot uses *reverse appraisal* to understand the meaning of *neutral* according to the *collaborative task status* (e.g., precondition status, postcondition status, required resources, shared goal). Robot updates human's *user model* respectively.

[Robot will not be able to update human's user model correctly based on his reverse appraisal, since it is missing human's worriedness (consequence on human's user model).]

3. (**Appraisal**): Robot *appraises* Astronaut's utterances.

[Robot will not be able to appraise the external event correctly, since it misses human's emotion (consequence on Appraisal mechanism → As a side effect of wrong appraisal the Coping mechanism will act incorrectly → As another side effect, this leads to incorrect values of mental state attributes, e.g., Accuracy of a belief, Certainty or Affective-Deliberative Consistency of an intention, Difficulty of a goal, Failure Disruptiveness or Importance of a motive).]

4. (**Collaboration , Motivation → Motive Formation → Belief Formation → Intention Formation**): Robot forms new motives according to the Astronaut's request, and the result of a) *appraisal* with respect to the *shared goal*, and b) *reverse appraisal* of the human's wrong emotion (i.e., neutral). Robot forms new beliefs about a) status of the current tasks, and b) the new given task. Robot forms new intention(s) with respect to the new beliefs.

- [Robot will not be able to form required/appropriate motive according to the human's real emotion (i.e., frustration). As a result, there will be no motive to remove Astronaut's frustration, and similarly no correct motive to agree on the shared goal (consequence on **forming motives**).]
- [Robot will not be able to form proper beliefs according to the task status, human's mental states and appraisal of the event (consequence on **forming beliefs**).]
- [Robot will not be able to form proper intentions according to the corresponding beliefs (consequence on **forming intentions**).]

5. **(Collaboration , Mental States, Coping)**: Based on the current mental states, Robot decides to use *problem-focused* coping strategy of *active coping* to be able to drop the intention of helping the Astronaut. **(B2)**

[Robot will not be able to choose proper coping strategy because of forming wrong mental states (consequence on **Robot's behavior**).] => ***This goes on till the end of interaction.***

** Robot perceives human's new utterance, just as above procedure. **(B3)**

6. **(Collaboration , Mental States, Coping):** Based on the current mental states, Robot decides to use *problem-focused* coping strategy of

planning to be able to execute the required task by the Astronaut. **(B4)**

** Robot perceives human's new utterance, just as above procedure. **(B5)**
7. **(Collaboration , Mental States, Coping):** Based on the current mental states, Robot decides to use *problem-focused* coping strategy of *seeking social support (seeking information)* to be able to execute the required task by the Astronaut. **(B6)**

** Robot perceives human's new utterance, just as above procedure. **(B7)**

8. **(Collaboration , Mental States, Coping):** Based on the current mental states, Robot decides to use *problem-focused* coping strategy of *active coping* to be able to execute the required task by the Astronaut. **(B8)**

** Robot perceives human's new utterance, just as above procedure. **(B9)**

9. **(Collaboration , Mental States, Coping):** Based on the current mental states, Robot decides to use *problem-focused* coping strategy of *planning* to be able to execute the required task by the Astronaut. **(B10)**

** Robot perceives human's new utterance, just as above procedure. **(B11)**

NOTE: As a result Robot will show emotionally detached behaviors and consequently will not be able to maintain proper shared awareness which leads to distrust of the Astronaut.