A Taxonomy of Empathetic Questions in Social Dialogs
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**Motivation**
- Questions play important social function in empathetic dialogs.
- Generating meaningful questions is a central objective of open-domain chatbots.
- This is challenging, especially due to the lack of modeling resources.

**Taxonomy Development**

<table>
<thead>
<tr>
<th>12 question intents:</th>
<th>9 question acts:</th>
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<tbody>
<tr>
<td>- Express interest (57.1%)</td>
<td>- Request information (38.7%)</td>
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<tr>
<td>- Express concern (20.3%)</td>
<td>- Ask about consequence (21.0%)</td>
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<td>- Offer relief (4.8%)</td>
<td>- Ask about antecedent (17.1%)</td>
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<td>- Sympathize (3.9%)</td>
<td>- Suggest a solution (8.7%)</td>
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<td>- Support (2.6%)</td>
<td>- Ask for confirmation (5.8%)</td>
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<td>- Amplify pride (2.6%)</td>
<td>- Suggest a reason (5.2%)</td>
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<td>- Amplify joy (1.6%)</td>
<td>- Ask about consequence (3.6%)</td>
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<td>- De-escalate (1.6%)</td>
<td>- Positive rhetoric (1.0%)</td>
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<tr>
<td>- Pass judgement (1.6%)</td>
<td>- Negative rhetoric (1.3%)</td>
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**Analysis of Questioning Strategies**

- **Positive**:
  - Express interest, Request info
  - Express interest, Ask about consequence
  - Express interest, Ask about antecedent
  - Express interest, Suggest a reason
  - Express concern, Request info
  - Express concern, Ask for confirmation
  - Express concern, Ask about antecedent
  - Express concern, Ask about consequence

- **Neutral**:
  - Express interest, Request info
  - Express interest, Ask about consequence
  - Express interest, Ask about antecedent
  - Express interest, Suggest a reason
  - Express concern, Request info
  - Express concern, Ask for confirmation
  - Express concern, Ask about antecedent
  - Express concern, Ask about consequence

- **Negative**:
  - Express concern, Ask about antecedent
  - Express concern, Suggest a reason
  - Suggest a reason
  - Ask about consequence
  - Ask for confirmation

- **General**: Express interest + Request info dominate, no influence on emotions.
- **For positive (>60% preserved)**: Amplify emotion + Request info/Ask about consequence.
- **For negative (>50% alleviated)**: Express concern + Ask about ant./cons, Sympathize + Ask about ant./cons, Offer relief / De-escalate + Suggest a solution.

- # questions drops with dialog depth.
- Reaction to positive contexts is immediate, while negative contexts require extra clarifications.

**Annotation**

- **Mturk Setup**
  - 40% of ED dialogs
  - 25 dialogs per HIT
  - 3 workers per HIT ⇒ majority voting

- **Mturk Results**
  - 5,826 annotated intents (71.6% agr)
  - 6,433 annotated acts (68.0% agr)

- **Data Augmentation**
  - Sentence-BERT framework to encode questions with contexts.
  - k-NN majority vote on cos similarity
  - 0.825 cos similarity with k=3
  - ~76% CV accuracy

- **Classification**
  - 2 QBERT classifiers
  - Trained separately for acts & intents
  - 5,826 annotated intents (71.6% agr)
  - 25 dialogs per HIT

- **Results**
  - 74.7% CV accuracy of QBERTs
  - Accuracy of QBERTs:
    - Acts
    - Intents
  - 79.1% CV accuracy

- **Analysis**
  - 5,475 annotated intents (60% preserved)
  - 4,969 annotated acts (58.3% preserved)
  - Human proxy
  - Human proxy

- **Reached**
  - 92% Act
  - 92% Intent

- **Sample**
  - Empathetic Dialogues
  - 300 dialogs
  - 2 experts