Justifiable reasons for everyone: Dialogical reasoning in patients with schizophrenia

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Abstract

Patients with schizophrenia are known to have difficulties in reasoning, but previous work has not looked at how such deficits manifest in face-to-face interactions. Using a unique corpus of triadic interactions discussing a moral dilemma, half of which involve a patient with schizophrenia, we show that patients are more likely than their interlocutors and control groups to provide arguments which reject the constraints of the task. Patients are also more likely to be consistent in their reasoning across a dialogue than their interlocutors or controls. Our results suggest that patients do not have impaired reasoning abilities but rather reason on the basis of a different view of the task than non-patients.

1 Introduction

This paper investigates reasoning and argumentation in dialogues involving patients with schizophrenia. Patients perform poorly on social cognitive assessments designed to examine the mental operations underlying social interaction (Green et al., 2015). They show difficulty inferring what others are thinking (Brüne, 2005), and a bias towards jumping to conclusions when making decisions (Dudley and Over, 2003; Serrano-Guerrero et al., 2020). However, few studies have investigated how patients actually verbalise their reasoning during actual social encounters, or how patients' ability to reason influences their interactions more broadly.

To investigate this we examined the reasoning of patients, and their interacting partners, during triadic face to face social interactions. The reasoning in dialogues including a patient was compared to those seen in comparable control interactions. Crucially, for our purposes, the non-patients interacting with a patient were unaware of the patient's diagnosis, thus avoiding the potential changes to behaviour observed in interactions with patients with schizophrenia that can be attributed to stigma (Perry et al., 2011). Across all interactions, participants were asked to discuss a moral dilemma and reach an agreement. The dilemma stated that there were four passengers in a hot air balloon which was falling and one passenger needed to be sacrificed to save the remaining three. This task is known to elicit chains of reasoning, as shown in example (1), which we return to in section 3.2, below.

(1) Group 13, lines 32–39

3: But cancer research scientist. That's the type of research he must have lots of notes

1: But that's what I'm thinking I'm sure I'm sure there's notes there somewhere. That someone else can work on what he did.

3: And let's give the child a future cause she is a prodigy so th- that the cancer research scientist

1: Well she is a prodigy but having said that you know, like, what's she gonna do for anyone?

2 Background

Schizophrenia is a severe psychiatric disorder that affects millions of people worldwide. Patients are known to have difficulty with language (Covington et al., 2005; Stephane et al., 2014) and reasoning (Hooker et al., 2000; Zajenkowski et al., 2011; Contreras et al., 2016; McLean et al., 2017), and difficulty interacting with others is one of the most debilitating features of the disorder. However, the reasons for patients' social deficits are poorly understood and treatment options remain limited (Horan and Green, 2017).

A wealth of evidence suggests that patients have difficulty perceiving and interpreting social cues

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from the world around them including interpreting others' emotions and inferring others' thoughts (Green et al., 2015; Brüne, 2005; Penn et al., 2008). Patients with schizophrenia have also been identified as having reasoning deficits, particularly biases of jumping to conclusions and evidence integration (Dudley and Over, 2003; McLean et al., 2017; Serrano-Guerrero et al., 2020). This means that patients are quicker to reach conclusions, possibly based on more limited evidence, and also more likely to stick with their initial conclusion even in the face of new evidence, suggesting that they are less flexible in their reasoning. Moreover, it has been hypothesised that reasoning impairments may underpin patients' social deficits (Corcoran and Frith, 2005).

However, these findings are derived from the results of pen and paper cognitive tasks, completed in isolation. They differ substantially from actual social interaction with others and it is unclear if patients' performance on such tasks reflects their social deficit as it presents during actual social interactions. Indeed, recent evidence suggests that patients' performance on such reasoning tasks reflects the cognitive demands of the task rather than patients' reasoning ability per se (Klein and Pinkham, 2018).

The few studies that have investigated patients' social interactions directly reveal that patients display atypical patterns of participation (Lavelle et al., 2014). Furthermore, the presence of a patient with schizophrenia in an interaction influences the non-verbal behaviour of their interacting partners, both in clinical contexts (Lavelle et al., 2015) and during first meetings with unfamiliar strangers, despite the diagnosis of the patient being undisclosed to their interacting partners (Lavelle et al., 2013, 2014). Studies indicate that this is also true in dialogue for disfluencies (Howes et al., 2017), and the relationship between self-repair and gesture (Howes et al., 2016).

This preliminary study aims to assess whether the results from offline cognitive tests which show reasoning deficits in patients generalise to face-to-face interactions with healthy participants. We are also interested in investigating whether healthy interlocutors reasoning behaviour is influenced by the presence of a patient (without this being explicitly known), as is the case for non-verbal behaviours (Lavelle et al., 2013, 2014) and turn-taking cues (Howes et al., 2017).

Specifically we investigate the following three questions:

1. Compared to participants in the control group interactions, do patients provide fewer reasons for saving/throwing the passengers?

2. Does the presence of the patient in an interaction lead to a different pattern of reasoning in patients' healthy participant partners?

3. Are patients less flexible/more consistent in their argumentation compared to healthy controls?

3 Method

3.1 Participants

The corpus, described in more detail in Lavelle et al. (2013), consists of 40 triadic conversations of approximately five minutes. There are 20 interactions involving one patient with a diagnosis of schizophrenia and two non-psychiatric controls who were unaware of the patient's diagnosis. The 20 control interactions each involved three healthy participants. Participants within each triad were unfamiliar to each other. For both the control group and the patient group one dialogue was not correctly recorded. The data available for analysis therefore consists of 19 patient interactions and 19 control interactions.

3.2 Task

The subjects discussed the balloon task – a moral dilemma which requires participants to reach agreement on which of four passengers should be thrown out of a hot air balloon that will otherwise crash, killing all the passengers, if one is not sacrificed. The four passengers are:

William Harris – the balloon pilot who is the only passenger with any balloon flying experience

Susanne Harris – William's wife, a primary school teacher who is 7 months pregnant with their second child

Dr Robert Lewis – a cancer research scientist, who believes he is on the brink of discovering a cure for most common types of cancer

Heather Sloan – a nine-year old musical child prodigy who is considered by many to be a "twenty-first century Mozart"

This task is known to elicit dialogues containing extended reasoning sequences, as illustrated in example 1. In this short extract, typical of the exchanges of reasons the task elicits, participant 3 provides a reason for not saving Dr Robert Lewis ("he must have lots of notes"), which participant 1 elaborates on ("I'm sure there's notes there somewhere. That someone else can work on what he did"). Subsequently participant 3 offers a reason to save Heather Sloan ("let's give the child a future cause she is a prodigy"), while participant 1 provides a possible reason not to save her ("Well she is a prodigy but having said that you know, like, what's she gonna do for anyone?").

3.3 Annotation

The dialogues were video recorded and motion captured. They were transcribed for the verbal content using ELAN (Wittenburg et al., 2006).

As the transcriptions were segmented based on the sound properties of the interaction, a single turn can be transcribed as multiple utterances, where there are within turn silences. For the purposes of our study, we call a turn a stretch of talk by a single speaker, regardless of how many sub-utterances it contains. As we treat a change of speaker to indicate a new turn, this means that some contributions which should in fact be counted as single turns may be broken up by intervening (even overlapping) material by another speaker, such as a backchannel (Yngve, 1970; Kjellmer, 2009). This pattern of interleaving of turns and utterances is a known issue in quantificational dialogue research (Purver et al., 2009) and decisions about what counts as a turn or an utterance may have consequences for comparisons to other work, though as we treat all groups the same here, it can just be considered as noise in the data.

These anonymised text transcripts were used as the basis for the annotation of reasons. Annotators were not aware which participants were patients or even which dialogues were the control dialogues and which contained a patient.

The annotation involved a two step process. First, each utterance was coded for whether it related to any of the passengers in the balloon, or all of them. The annotators were prompted by the question: "Who does the utterance relate to?" These were not mutually exclusive categories – the same utterance could relate to several of the people in the balloon, and could be marked as such. The 'relates to everyone category' was only used if the participants were described collectively. Two of the dialogues were annotated by two of the authors. Cohen's kappa was between 0.65 and 0.9 for each of the categories relating to a person in the balloon.

The second stage examined those utterances which had previously been marked as being about one of the passengers (or everyone) and answered the question "Does the utterance make an argument that is directly or indirectly a reason for saving or not saving one, or all, of the passengers?". Where the reasoning in the turn spanned several utterances annotators were instructed to only annotate the final utterance of the reasoning sequence. Examples are shown in Table 1. Cohen's kappa for the two dialogues annotated by multiple authors was between 0.60 and 0.88 for each of the "reasons for" categories, despite the relatively few cases in some of the categories.

4 Results

As can be seen from table 2, patients produce fewer reasons on average than both their partners and controls. However, this is mediated by the amount of speech that participants produce – when we normalise by the number of turns (as seen in Table 3) there is no significant difference in the total proportion of reasons given between the participant types. Although on average there is a smaller proportion of patients' turns which contain a reason, there is wide variation in the numbers.

4.1 Number of reasons

While it appears that patients produce fewer reasons per turn in a number of categories (as seen in Figure 1 and Table 3), the wide variability and small number of cases in the data means that these numbers are not statistically significant. However, even taking into account the low power of analyses, which are based on one value per individual, we do see significant differences in the Save Everyone and Don't Save Anyone categories.

Of the total number of reasons provided by patients, as compared to both their partners and the control group, a higher proportion are about saving (or not saving) everyone. Reason to save everyone: $\chi^2_2 = 13.81, p = 0.001$; Reason to not save anyone: $\chi^2_2 = 16.95, p < 0.001$. This means that although patients are providing a similar number of reasons per turn as both their partners and controls, more of the reasons they give are a rejection of the

Text	Reason for
And let's give the child a future cause she is a prodigy	Save_Prodigy
Well she is a prodigy but having said that you know, like, what's she gonna do for anyone?	Don't_Save_Prodigy
if the wife jumps over, it means that she will die and her her unborn baby will die, so I mean that's two people who'll die	Save_Woman
the pregnant one would probably be the heaviest	Don't_Save_Woman
if Tom goes I think that nobody can drive this balloon	Save_Pilot
I would throw out the pilot and get the pilot to teach them how to fly the hot air balloon	Don't_Save_Pilot
The doctor could save lives	Save_Doctor
he's coming to like discovering this new cure, but he's probably been working with others	Don't_Save_Doctor
Think about how many child prodigies that we could save with Robert Lewis's cancer treatment	Save_Doctor; Don't_Save_Prodigy
Nobody's gonna go they they can control the balloon	Save_Everyone
Everybody should go down with the ship	Don't_Save_Anyone

Table 1: Annotation examples

	Patient			Patients' Partner			Controls			Total		
	Mean	Count	s.d.	Mean	Count	s.d.	Mean	Count	s.d.	Mean	Count	s.d.
Save Reasons	6.37	121	4.65	9.42	358	6.11	10.96	625	7.80	9.68	1104	6.96
Don't Save Reasons	4.21	80	4.37	7.50	285	5.76	7.58	432	5.86	6.99	797	5.70
Total Reasons	10.58	201	7.99	16.92	643	10.67	18.54	1057	12.31	16.68	1901	11.42
Total Turns	50.37	957	32.49	62.00	2356	31.10	66.58	3795	38.25	62.35	7108	35.26

Table 2: Overview of reasons given (raw data)

constraints of the task (which specifically states that the participants should come to an agreement about which of the passengers to throw out).

4.2 Consistency

Visual inspection of the dynamics of the reasons given in each triad (see Figures 2 and 3 for examples) suggested that the patients were more consistent in their reasoning in the sense that they did not seem to be as likely to produce a reason for and against the same individual, and produce arguments for or against fewer of the four individuals in the balloon.

These impressions were confirmed. In order to assess consistency, we used a very simple binary measure (consistent/inconsistent). Each participant was classified as inconsistent if they provided at least one argument for and against throwing the same individual, and consistent otherwise. In our data, patients are more likely to be consistent in the reasons they provide with 10 out of 19 patients (53%) not providing a reason both for and against the same individual, compared to 9 out of 38 of their partners (24%, $\chi^1_2 = 4.78, p = 0.03$) and 10 of 57 controls (18% $\chi^1_2 = 9.05, p = 0.003$).

For the number of individuals arguments were provided for or against, 11/19 of the patients (58%) produced arguments for 2 or fewer individuals, compared to 13/38 of their partners (34%, $\chi^1_2 = 2.91, p = 0.09$ not statistically significant, but a trend in the expected direction) and 14/57 of the healthy controls (25%, $\chi^1_2 = 7.17, p = 0.007$).

4.3 Qualitative observations

In this section we will present some examples that illustrate the patterns identified in the quantitative data, i.e. that patients appear less inclined to stick to the rules set up in the hypothetical situation and rather treat it as a situation in which they are themselves present. The impact of patients' behaviour on their interacting partners will be presented and the potential rationale for patients' reasoning will be discussed.

4.3.1 Save everyone or no-one

In examples 2 and 3 below, the patient (in bold) refuses to accept the premise of the task and instead argues that everyone should jump from the balloon (example 2) or no-one should jump from

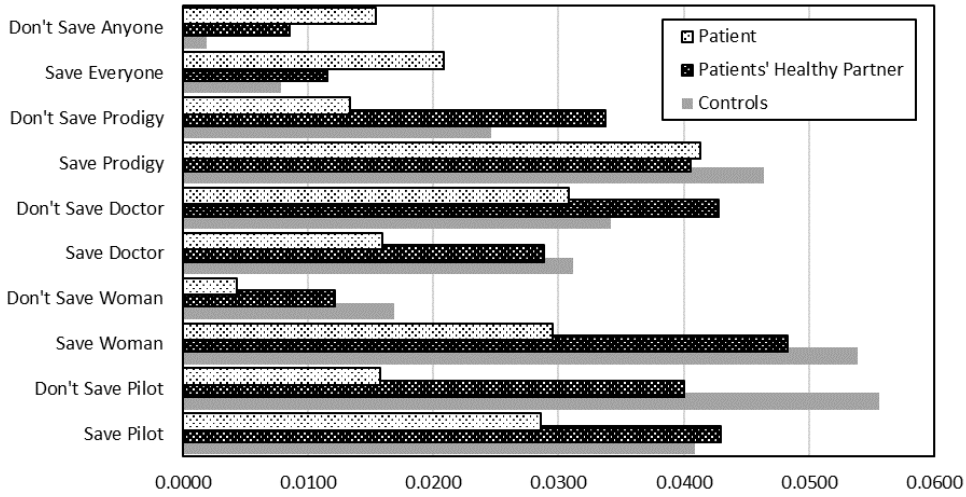

Figure 1: Reasons per turn by participant type

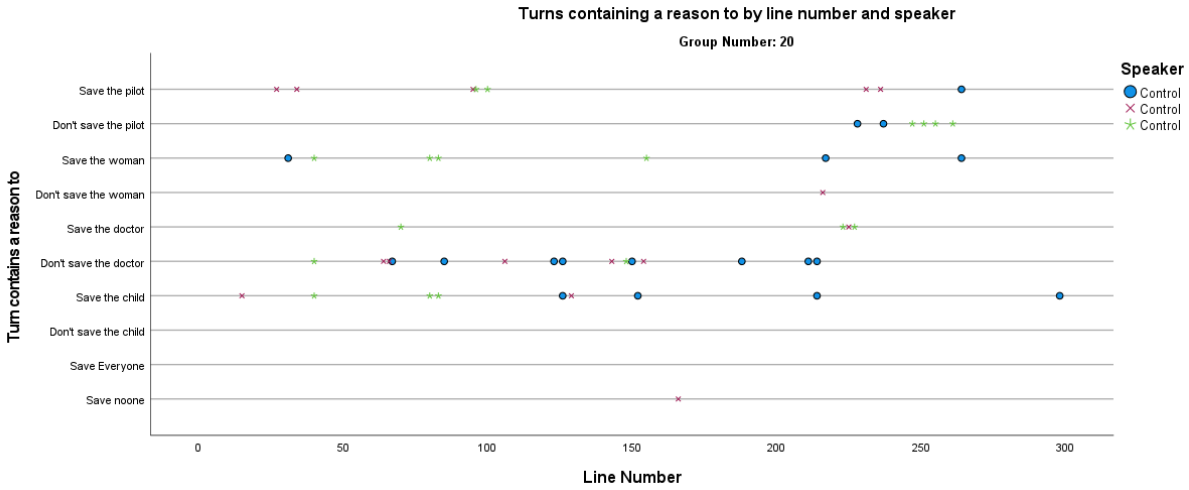

Figure 2: Single control dialogue showing the sequentiality of reasons given throughout the dialogue

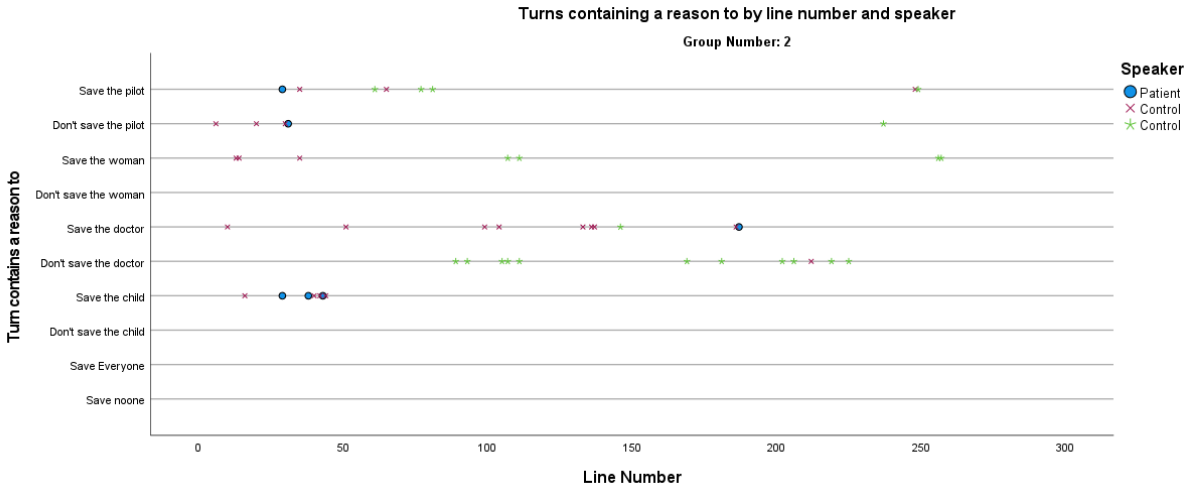

Figure 3: Single patient dialogue showing the sequentiality of reasons given throughout the dialogue

	Patient		Patients' Partner		Controls		Total	
	Mean	s.d.	Mean	s.d.	Mean	s.d.	Mean	s.d.
Save Pilot	0.029	0.032	0.043	0.054	0.041	0.043	0.040	0.045
Don't Save Pilot	0.016	0.034	0.040	0.053	0.056	0.078	0.044	0.066
Save Woman	0.030	0.050	0.048	0.055	0.054	0.065	0.048	0.060
Don't Save Woman	0.004	0.013	0.012	0.036	0.017	0.035	0.013	0.033
Save Doctor	0.016	0.024	0.029	0.042	0.031	0.037	0.028	0.037
Don't Save Doctor	0.031	0.048	0.043	0.064	0.034	0.050	0.036	0.054
Save Prodigy	0.041	0.042	0.041	0.040	0.046	0.046	0.044	0.043
Don't Save Prodigy	0.013	0.029	0.034	0.056	0.025	0.035	0.026	0.043
Save Everyone	0.021	0.055	0.012	0.026	0.008	0.021	0.011	0.031
Don't Save Anyone	0.015	0.034	0.009	0.024	0.002	0.006	0.006	0.021
Total Save Someone	0.136	0.094	0.172	0.121	0.180	0.119	0.170	0.116
Total Don't Save Someone	0.080	0.070	0.137	0.098	0.133	0.121	0.126	0.108
Total Reasons	0.216	0.122	0.309	0.190	0.313	0.221	0.296	0.199

Table 3: Reasons given for saving or not saving each person by number of turns

the balloon (example 3), both scenarios resulting in everyone dying. From a utilitarian point of view, this is not very rational as no one is spared. On the other hand it might seem more *fair* that one person is not sacrificed.

(2) Group 3, lines 163–170

3: [you just have] to you have to accept everybody you have to [accept]
1: [everyone.]
1: yeah.
3: [<unclear/>]
2: [You think] we should all jump?
3: I think
3: well that er th- ah everybody should go down with the ship, yeah

In example 2, the patient's interacting partners do not appear to challenge the patient's deviation from the task rules. Participant 2 does request clarification of what the patient has said (*you think we should all jump?*) suggesting that the patient's argument requires further discussion, but they make no explicit reference to this being outside of the premise of the task. Furthermore, patients' partners use the term *we* should jump rather than *they* suggests that they may be adopting the patient's interpretation of the task being about themselves rather than abstract individuals. This pattern may indicate a compensation by the patient's interacting partners to the rigid stance of the patient.

By contrast, in example 3, the patient's partners become increasingly explicit about the fact that the patient has deviated from the premise of the task. This is demonstrated by participant 3 firstly asking the patient directly (*who do you think should go?*). Following the patient's response (*nobody's gonna go...*), participant 1 explicitly acknowledges the problem with it and restates the premise of the task. Eventually participant 1 presents the patient's position to them, although it is clear from the dialogue that they do not understand or share it (*but you're hoping on a miracle then*).

(3) Group 5, lines 88–107

3: [Well who do you think should go?] Who do you think should
2: Nobody's gonna go they they can control the balloon
2: knows the pilot
2: but he don't want to [<unclear/>]
1: [But one of] them has to go
1: one of [the four]=
3: [has to]
1: = has to go
2: [<unclear/>]
1: [Otherwise] they [all die.]
2: [I don't know.]
2: I don't know.
2: If you're gonna die, the pilot is there.
1: But that's the premise of the issue [that there a-]
2: [No I don't I] don't think they're gonna die.

1: <laughter/> [<laughter/>]

2: [I can <unclear/>] let's save them with that other people you know how they want to save themselves

1: [Right].

2: [<unclear/>] <unclear/>

1: But you're hoping on a miracle then.

4.3.2 Consistency of position

Examples (4)–(6) are extracts from the same dialogue demonstrating the consistency of one patient's arguments and rationale over the course of an interaction. Patients' pattern of consistency suggests a rigidity in their ability to consider multiple alternative view points, which aligns with findings from cognitive tests (García-Mieres et al., 2020). In the current example the patient (participant 2) states that the woman should be saved and presents their reason as (*it's two people, there's a baby there as well*). The patient states their argument to save the woman in response to an alternative view of one of their interacting partners (participant 3), and prefaces their reason with a moral value judgement (*it's just not right*).

(4) Group 4, lines 55–72

3: [Well] all the all his wife has got going for her

1: <laughter/> [<laughter/>]

3: [is that] his

3: she's his wife.

3: And she's

3: expecting.

2: but it's it's just not right

2: **it's two people.**

2: **there's a baby there as well**

1: yeah.

3: yeah [I know.]

1: [it is]

1: You're [killing two]=

2: [<unclear/>]

1: = lives [not just one]=

2: **[so there's two] [lives in there]**

3: [but I still] that that means it goes back to the weight as well innit?

3: she's a little bit extra [you know]

Following a short interlude where the possibility of throwing the prodigy is discussed, they return to the question of the pregnant woman, who participant 3 still advocates for throwing. While participant 1 offers a new reason for not throwing the woman (*if you throw the wife out the pilot won't be able to control the balloon or he might jump off*), the patient reiterates the same reason they had previously offered for keeping the woman (*there's a baby...*). Following a further exchange she reiterates it again (*you'd be killing two lives*).

(5) Group 4, lines 91–110

3: = I personally would say throw the wife out.

3: That's probably the

3: pilot be happiest then.

2: No child [can deserve that.]

3: [<laughter/>][<laughter/>]

1: [<laughter/>]

2: **There's a baby you want there, his [baby]**

1: [yeah] [it's a bit bad]

3: [yeah, but]

1: and like I said I think

1: [<unclear/>]

3: [There ain't a baby] there

1: I think if you throw the wife out though

1: I think the pilot [will]=

2: [mmm.]

1: = s-

1: won't be able to control the balloon [or he might]=

2: [mmm.]

1: = jump off

2: **and you'd be killing two lives too**

Between extract (5) and (6), participant 3 concludes that they have to keep the doctor and the only choice is between the child prodigy and the wife. At this point in the dialogue the healthy participants have presented and discussed multiple arguments for and against throwing the wife, while the patient continues to reiterate the same argument – that throwing the wife of the pilot involves sacrificing the unborn child.

In example (6) again, we see evidence of the patient deviating from the abstract and hypothetical nature of the task and discussing it as though they were involved. For example, when discussing throwing out the pregnant woman the patient states *I couldn't live with myself*. The patient justifies

their decision to keep the woman based on personal lived experience (*cause I'm a mother*).

(6) Group 4, lines 141–153

3: but the baby's not born yet.
3: <laughter/> [<laughter/>]
2: **[no but it's a] it's a life isn't it ?**
3: It is a life but
3: the baby's [not]
2: [couldn't] live live with myself.
2: Do you know what I mean
1: Right.
2: Cause I'm a mother <laughter/> [<unclear/>]
3: [I'm a fa]ther
2: [Because]
3: [<laughter/>] <laughter/>
2: Well you never carried a baby.

5 Discussion

Patients provide a similar number of reasons per turn as non-patients but a greater proportion of the patients' reasons involve rejecting the constraints of the task. This might have to do with the fact that patients have greater difficulty in seeing the task as a kind of abstract game as opposed to an imagined real-life situation in which decisions have to be made. Task based assessments have shown that schizophrenia patients have difficulty employing abstract thinking, which may account for this finding (Flavell, 1956; Oh et al., 2014).

Patients were shown to be more consistent than non-patients in that they produced fewer arguments both for and against throwing a particular person. This could indicate a lack of ability or willingness to weigh different arguments against each other. This pattern may stem from a cognitive rigidity, which has been identified in patients with schizophrenia using cognitive tests (García-Mieres et al., 2020). It may also be consistent with viewing the task as an imagined real-life situation rather than as an abstract game.

We plan to further investigate why this might be the case in future work, as our current analysis does not distinguish between several possible causes. For example, it may be that patients are simply more defensive or less engaged with the task (which would be consistent with their on average shorter dialogues) or it might be that that they find it hard to reason counterfactually, or that something about their experience as patients makes them take a different moral stance.

Our qualitative analysis suggests that patients' partners may choose to manage patients' deviation from the task in two ways: i) to adapt to the patient's position and discuss the task as the patient has interpreted it; ii) to explicitly tell the patient that they have deviated from the task rules. This may have implications for the success of these interactions and how they are experienced by the interacting partners.

In general our results suggest that patients do not have an impaired reasoning ability but rather reason on the basis of a different view of the task than that of the non-patients. Furthermore our qualitative results suggest that the patients offer fewer different types of reasons for the same conclusions (e.g. *do not throw the pregnant woman*) compared to healthy participants and controls. In order to investigate this hypothesis further, we are currently annotating the types of reasons given by patients, patients' partners and controls to find out how these differ between the different groups and the impact this has on the interaction success.

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