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THE IMPORTANCE OF ANXIETY IN UNDERSTANDING HOW DECISION MAKING IS AFFECTED IN AUTISM SPECTRUM DISORDER

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SUMMARY

Autobiographical and clinical accounts of individuals with autism spectrum disorder (ASD) have highlighted that these individuals experience several difficulties during the decision making process. A review of the experimental based studies assessing performance in decision making tasks compared to controls emphasizes key differences including altered risk preferences, decreased sensitivity to social rewards, increased deliberative reasoning and atypical integration of emotional cues. Despite several attempts to devise cognitive theories to explain these differences, none so far can account for all the differences seen. However, one key observation, consistent with clinical accounts, is elevated levels of anxiety in populations with ASD. Whilst this has traditionally been considered a bi-product of the decision making process, I argue that increased anxiety may directly influence decision making in individuals with ASD, through 2 main routes. Firstly, elevated anxiety overwhelms Type 1 (intuitive) fast processes (within the Dual Process Model), leading to a decision making style biased by Type 2 (deliberative) processes. In addition, heightened anxiety decreases cognitive flexibility, leading to a more logic based, deliberative decision making style. This is superimposed on pre-existing cognitive impairments which altogether may account for the differences seen. Therefore, anxiety must be considered as a key variable in cognitive models of decision making in ASD. Specific recommendations for future research exploring the role of anxiety are discussed.

Key words: *anxiety – autism spectrum conditions/disorder (ASC/ASD) – decision making*

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INTRODUCTION

Autism spectrum disorder is a heterogeneous set of neurodevelopmental disorders characterized by impaired social interactions, restrictive interests and repetitive behaviors (Landa 2008). Green et al. (2000) reported that <5% of adults with ASDs are rated by their parents as being able to buy items, plan their routine or make decisions about self-care. To understand the impairments in decision making, the literature has focused on autobiographical and clinical accounts of individuals with ASD, as well as a limited number of experimental studies directly comparing decision making in ASCs and controls.

Both experimental studies and clinical accounts of individuals with ASD report that a frequent issue observed is heightened levels of anxiety. Anxiety can be defined as a feeling of uneasiness, usually generalized as an overreaction to a situation that is only subjectively seen as menacing. Here, we assess the contribution that elevated anxiety may make to the decision making process in individuals with ASD by evaluating three questions: what are the differences in decision making between individuals with ASD and controls, what is the evidence for increased anxiety in ASD and finally, how this may influence decision making to explain the differences seen in decision making in the experimental studies.

DIFFERENCES IN DECISION MAKING

A review of the experimental studies highlighted several abnormalities in decision making, relating to 6 main cognitive processes – as summarized in Table 1. This included an altered sensitivity to risk as assessed by the Iowa Gabling task, an increased reward preference for circumscribed interests in the absence of social rewards, increased deliberation as well as a decrease in sensitivity to contextual stimuli and cognitive flexibility. In particular, Damiano et al. (2012) highlights a failure to integrate emotional cues into the decision making process, basing their decisions using increased levels of logical reasoning.

EVIDENCE FOR ANXIETY IN ASD

There is converging evidence from a large number of sources that elevated levels of anxiety is a substantial issue in autism spectrum disorder. Autobiographical accounts provide excellent qualitative insight, allowing individuals to express the difficulties they face during decision making in their own words. For example, Jen Birch highlighted how she needs "more time than the average person in order to weigh up my options, come to a decision, cope with the sudden change of options… it is the moment of decision-making which is often the difficultly for me." (Birch 2003). Clinical reports reinforce the notion that anxiety is a pertinent issue in ASD, as adults with ASD were almost three times more anxious than a comparison group and gained significantly higher scores on anxiety subscales of panic and agoraphobia, separation anxiety, obsessive-compulsive disorder and generalized anxiety disorder (Gillott 2007). Gillott et al. (2001) reported high-functioning children with autism to be significantly more anxious than normally developing controls. Seven out of their sample of

Table 1. Summarizing the results of lab-based experimental studies comparing decision making in ASD and controls

Aspect of decision making	Effect of ASD	Studies
Sensitivity to risk	No significant difference in overall performance on IGT	Johnson et al. 2006, South et al. 2008, Yechiam et al. 2010, Faja et al. 2013, Mussey et al. 2014
	More advantageous selections on IGT	South et al. 2014, Vella et al. 2017
	Increased switching between decks on IGT	Mussey et al. 2014
	No significant different on BART	South et al. 2011
Subjective representation of reward	Increased expenditure for rewards	Damiano et al. 2012
	Decreased rewards for social stimuli	Demurie et al. 2011, Damiano et al. 2012, Lin et al. 2012, Faja et al. 2013, Robic et al. 2015, Levin et al. 2015
	Increased temporal discounting	O'Connell et al. 2013, Chantiluke et al. 2014
	No difference in temporal discounting	Demurie et al. 2011, Demurie et al. 2013
Deliberative vs intuitive thinking	Increased deliberation	De Martino et al. 2008, Morsanyi & Holyoak 2010, Brosnan et al. 2013, Brosnan et al. 2014, Brosnan et al. 2016
Flexibility	Decreased flexibility in high error rate	Minassian et al. 2007
Sensitivity to contextual stimuli	Reduced sensitivity to contextual stimuli	Farmer et al. 2017
Integration of emotion	Failure to integrate emotional cues	Damiano et al. 2012, Brewer et al. 2015
General features	Increased response latency	Winter 2003, Luke et al. 2011, Vella et al. 2017
	Increased Anxiety + stress	Winter 2003, Luke et al. 2011, Southet al. 2011, Vella et al. 2017

15 children with autism were found to be clinically anxious as rated by the Spence Children's Anxiety Scale. Kim et al. (2000) also found elevated levels of separation anxiety as well as generalized anxiety in their sample, whereas Muris et al. (1998) found simple phobia to be the most common anxiety disorder in populations with ASC. Reinforcing these clinical based accounts, Luke et al. (2011) collected self-report data to examine the type of problems that people with ASD (n=78) experience during decision making. The data suggests that people with ASD often experience elevated anxiety, simultaneously with mental "freezing", mental exhaustion, slowness in reaching a decision, as well as a tendency to collect too much information, consistent with earlier findings from Winter (2003), who used a questionnaire and the General Decision Making Style inventory (Scott 1995). Therefore, despite relatively few attempts to evaluate anxiety in this population, there is significant interest in the idea that heightened anxiety is concomitant with autism.

HOW MAY ANXIETY INFLUENCE DECISION MAKING

Whilst there is substantial evidence for elevated levels of anxiety in populations with ASD, it is rarely included as a key variable in cognitive models of decision making in individuals with autism. Traditionally, the earliest models of decision making suggested formal models based on social and economic behaviour – with a key focus being on rational choice. In particular, with respect to choices involving risk, the Subjective Expected Utility theory (von Neumann 1947) assumed that people solely assess the severity and likelihood of the possible outcomes of choices and integrate this information using expectation-based calculus to arrive at a decision.

One model which addressed several of the findings in autism is the Dual Process Theory model which has been a dominant model within cognitive psychology for almost 50 years (Evans 2013). De Martino et al. (2008) hypothesized that individuals with ASD have an increased tendency towards deliberation, attributable to impairments within intuitive reasoning systems. Hence, a slower, effortful, deliberative reasoning style would be dominant in individuals with ASD, who demonstrate an 'unusual enhancement in logical consistency', which would also support the empathizing-systemizing (E-S) theory of autism (Baron-Cohen 2005). For example, during the framing task, ASD subjects are better able to ignore biasing contextual information and isolate critical information about the numerical value of the sure and risky options. This result is consistent with other experimental findings showing that ASD subjects have enhanced attention for the task's details but reduced capacity to deal with the global aspect of the task as predicted by weak coherence theory (Frith 1994). Whilst some argue that those with ASD have dominant deliberative reasoning due to impaired intuitive mechanisms, another possible explanation however, is that these intuitive mechanisms are intact in different contexts but this context triggers deliberative reasoning in those with higher levels of autistic traits.

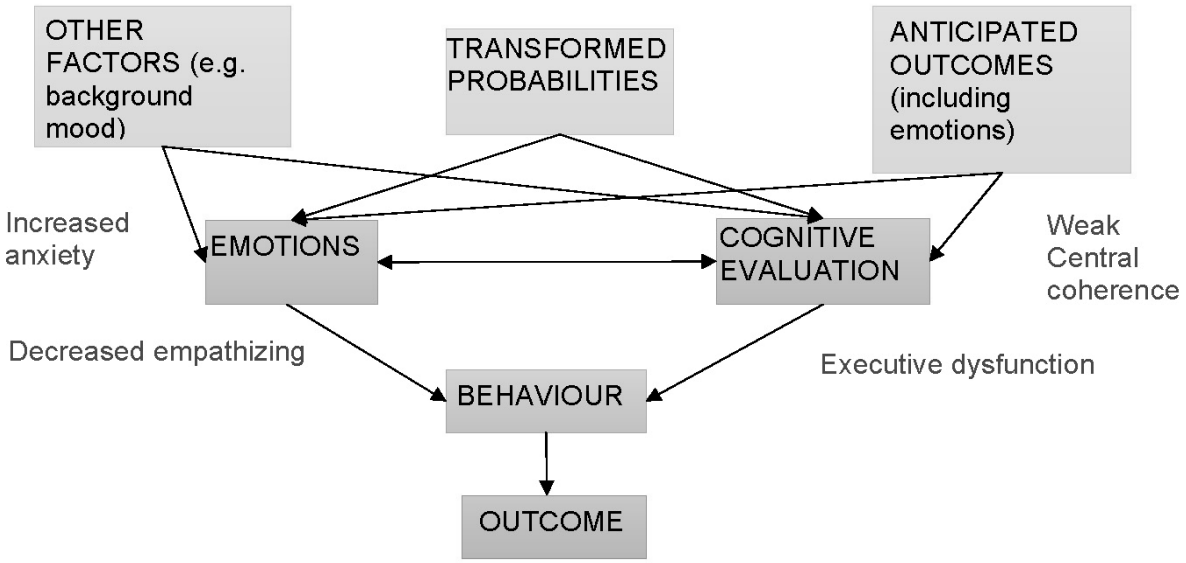

Figure 1. Diagrammatic representation of cognitive impairments seen in ASD superimposed on the risk-as-feelings model of decision making (Loewenstein 2001)

Whilst the Dual Process model addresses several of the findings regarding decision making in ASD, it ignores the effects of heightened anxiety, especially in social situations. Therefore, I argue that anxiety has a two-sided effect on the decision process. Firstly, rather than having impaired intuitive mechanisms as proposed by De Martino et al. (2008), I argue that the affective state (which contributes to type 1 processes) may become overwhelmed by high levels of anxiety in ASD. As there are limited cognitive resources to accommodate type 1 processes, it is plausible that elevated anxiety may reduce the influence of other Type 1 processes (other emotions, heuristics etc.) from influencing the decision making process, leading to a decision style that is dominated by Type 2 processes, contributing to a decision making style which appears to be more deliberative.

Secondly, heightened anxiety in itself may play a direct role in the decision making process. There has been research showing that decisions regarding risk (involving probabilities) use global, affect based responses: for example, the risk-as-feelings hypothesis (Loewenstein 2001), shown in figure 1, postulates that decision making results in part from direct (i.e. not cortically mediated) emotional influences, including feelings such as worry, fear, or anxiety, which directly feed into the decision making process.

Therefore, by considering anxiety as an input variable in the decision making process, increased anxiety may explain several of the findings within the studies:

- ***Risk preference*** –When people decide to choose a particular deck in the IGT (Bechara 1994) they need a certain level of confidence to persist with it. Heightened anxiety in ASD may decrease confidence about the contingencies of a particular deck, leading individuals with autism to switch between decks more often. Similarly, Leon & Revelle (1985) demonstrated a relationship between anxiety and the tendency to inefficiently select relevant from irrelevant cues in reasoning tasks (Leon 1985). Hence, highly anxious participants may require greater information sampling before having the confidence to choose a particular deck, explaining the slower rate in learning which decks are advantageous (Yechiam 2010).
- ***Subjective representation of reward*** – It is argued that social stimuli are more complex to process – this cognitive overload may exacerbate anxiety in individuals with ASD, explaining why social stimuli are perceived as less salient to people with the disorder. Furthermore, elevated levels of anxiety may explain the steeper temporal discounting seen in ASD (O'Connell 2013), as individuals strive to regain control of a situation by electing for a smaller immediate reward over a larger delayed prize.
- ***Deliberative thinking*** – The lack of confidence in one's decision making process may explain the need to acquire more information before making a decision, resulting in a circumspect reasoning bias (Brosnan 2013, 2014), and the appearance of a deliberative way of thinking - although this cannot be confirmed since anxiety levels were not measured in participants. This tendency of increased elaboration when making choices has previously been associated with high anxiety (Calvo 2003). However, this would be counterproductive in a complex decision-making task like the IGT in which declarative cues on the optimum gambling strategy typically only become available between trials 50 and 80 in healthy volunteers (Bechara 1997), explaining poorer performance seen by individuals with ASD in this task.
- ***Flexibility*** – When the error rate is high, it is argued that the constant mismatch between expectation and outcome may overwhelm cognitive resources and increase anxiety further. Hence this may lead to individuals with ASD picking an option they "know" already instead of switching between options, decreasing perceived cognitive flexibility (Minassian 2007).

- ***Integration of emotion*** – As discussed earlier the elevated anxiety may lead to an overwhelming of Type 1 intuitive cognitive resources which process emotion, leading to a failure to integrate other emotions during decision making (Brewer 2015), leading to decisions being operated by Type 2 (deliberative) processes.

It is important to note that increased anxiety cannot account for all the effects seen in decision making with ASD. Vella (Vella 2017) noted that increased anxiety was weakly associated with reduced information sampling. Furthermore, neurotypical subjects with experimentally induced anxiety, "jumped to conclusions" when completing the beads task (Lincoln 2010) collating less information before making a decision, in sharp contrast to the circumspect reasoning bias seen in people with ASD (Brosnan2014). However, in both these studies, there may have been significant variation in the impact of anxiety on reasoning styles.

It is critical to understand that the argument I have put forward about increased anxiety is not mutually exclusive with existing cognitive theories of autism (see Rajendran & Mitchell 2007 for a review). Instead, the effects of heightened anxiety maybe superimposed on the cognitive impairments highlighted by theories such as Executive Dysfunction and/or Weak Central Coherence, which altogether may account for more of the differences in decision making seen. Whatever the exact effect of anxiety is, the fact that it is commonly observed in ASD during decision making tasks (Luke 2011, Vella 2017), consistent with autobiographical (Birch 2003) and clinical accounts, it would seem unjust to exclude it from models of decision making in ASDs.

IMPLICATIONS FOR FUTURE

One of the main limitations of the research so far has been examining the effect of underlying anxiety on the decision making in ASD. In previous studies, the vast difference in the original levels of anxiety between ASDs and controls made it impossible to determine whether anxiety is a cause of the differences seen, or a result of the decision-making process. In future, as Luke et al. proposed (Luke 2011), it is worth including a control group with heightened anxiety to levels comparable with ASDs. In addition, experiments controlling for anxiety in ASD could be assessed by using interventions (Steketee 2000), or pharmacological "anxiolytics". To assist decision making in individuals with ASD, the literature emphasises using reassurance to address anxiety or trying to make decisions when the person is relaxed. There is evidence that cognitive behavioral techniques may be successful in alleviating anxiety in some people with ASDs (see Sze & Wood 2007). Finally, as increased anxiety leads to an increased deliberative style, providing examples where excessive deliberation is counter–productive such as deciding what to wear to work may help train more intuitive based thinking.

CONCLUSION

In conclusion, anxiety may play a significant role in the decision making process in individuals with ASD. I have argued that rather than failing to integrate emotional information into the decision making process, individuals with ASD have elevated levels of anxiety which may overwhelm Type 1 intuitive processes, and also directly feed into the decision making process to produce a more deliberative style of reasoning, which is superimposed on pre-existing cognitive impairments. In order to validate this hypothesis, experimental studies directly measuring anxiety levels or controlling for the effects of increased anxiety in ASD are required.

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