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Research Paper

Correlation of Explicit and Implicit Agency in Individuals with Anxiety

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ABSTRACT

Sensorimotor agency and Constructed agency are respectively paradigms of studying implicit and explicit agency. They are also referred to as sense of agency and judgement of agency and they both have implications in understanding how one perceives agents of action in motor actions of self as well as in the actions of others. This study studies how implicit agency, measured by intentional binding and explicit agency examined through a qualitative analysis of visual stimuli, present in individuals with self-reported symptoms of agency. While intentional binding is not correlated with the scores on the anxiety scale, the results nonetheless direct us to an understanding of how perceived control may present in individuals. The qualitative analysis revealed an increased perception and judgement of intentionality over accidentality in perceived actions of others overall and hence indicates the need for a more rigorous research design to study the same.

Keywords: *Temporal Binding, Anxiety, Explicit Agency, Implicit Agency*

Friedrich Nietzche claimed with certainty that free will does not exist. In defence, Riccardi states "an action ultimately originated if by backtracking the causal chain that lead to it we find that the last ring is the agent. Moreover, the agent's contribution cannot itself be the result of another causal chain starting outside of her." [1]. This roughly alludes to what can be considered the multitude of context that is applicable in the allocation of agency in everyday life. One does not enter a situation in isolation but is instead accompanied by a surfeit of background circumstances.

The concept of agency emerges from the human need to assert control over situations. It is the self-generated assertion of authority over one's actions. In the context of interpreting another situation outside of the self however, an individual is inclined to rely on their pre-existing knowledge of the context and the environment, past experiences and their affective state in that instant. There is significant research that has been conducted to try and understand how one's allocation of agency to instruments outside of oneself is deeply rooted in our linguistic capabilities or rather, our culture since separating the two functions is impossible. Culture forms a language and language in turn ultimately defines culture and all that it stands for.

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This study is also engrained in the same understanding that there are factors outside of the self that may play an integral role in our assignment of agency. These can be classified as exteroceptive cues and are often perceived via various multimodal visual and auditory stimuli.

There is a significant dearth in the literature regarding constructing agency in individuals with diagnosed anxiety or anxiety-like symptoms. Constructing agency, as reported by previous researchers, essentially involves not just an objective appraisal of the stimulus, but also social cues and their reflective judgement of the situation. Their judgement of the causal agency in an event is therefore impacted as such. This study therefore, first wishes to study this very phenomenon.

Sensorimotor agency is however dependent on the sensory feedback provided by the preceding motoric movement. The preceding motor movement, in a way, acts in a predictive manner to allow for efference copies to plan the following upcoming movements thereby regulating motor prediction. Sensorimotor agency thus relies on a spatio-temporal prediction generated by the continuous or uniform pattern of the preceding events. A disturbance in such can cause a modification in the sense of agency. A study examined a deficit in the prediction of action consequences in patients with schizophrenia that contributed to a distorted sense of agency over movements and events as commonly seen in the pathology in question[2]. The same can be studied in patients with reported symptoms of anxiety for a better understanding of how action prediction is

This study therefore, will examine the relationship or correlation between the two, the aforementioned construction of agency and sensorimotor agency in a population of young adults with reported symptoms of anxiety.

Statement of the problem

This study aims to understand how agency is allocated in the context of self and others in individuals with reported symptoms of anxiety. The interaction of the two can help further locate the patterns of intrusive thoughts and agency in anxiety disorders.

Significance and Rationale of the study

Agency allocation is one of the major components that drive the other symptoms seen in anxiety disorders. The recurrent feelings of fear and behavioural patterns of submissive and unassertive behaviour too can be traced to the same. In therapy as well, a patient is often seen receiving CBT wherein self-image is reconstructed and agency is restored. Understanding the deeper underlying mechanisms of the same can therefore be quite an integral addition to the existing literature.

Agency, as aforementioned, refers to the feeling of control over action and its consequences. Research provides a non-exhaustive overview into what is generally classified as being agency and how it can be understood under terms of the human condition[3].

The distinction on the feeling of agency [FOA] and judgement of agency [JOA] has been described by previous literature.[4] The JOA is what we are primarily interested in and it classifies as a complex and higher order conceptual judgement that takes place while assigning agency to oneself to another. It requires a processing of our previously contained knowledge as well as our appraisal of the current world/ contextual setting in concurrence with our beliefs.

A sense of agency is not considered to be an estimation of the objective reality as presented to an individual. Instead, in cooperation with our pre-existing beliefs and past experiences, one can conclude that agency allocation, as one may define it, is more a reflection of our subjective evaluation of our environment. It contains within its scope, the impact of an individual's ongoing or prevailing affective states as well. The judgement is also, again, a good indicator of their psyche in that it expresses the manner in which they see the world, either from an ego centric perspective, a morality perspective wherein they take into account the social and moral requirements and underpinnings of the situation etc.

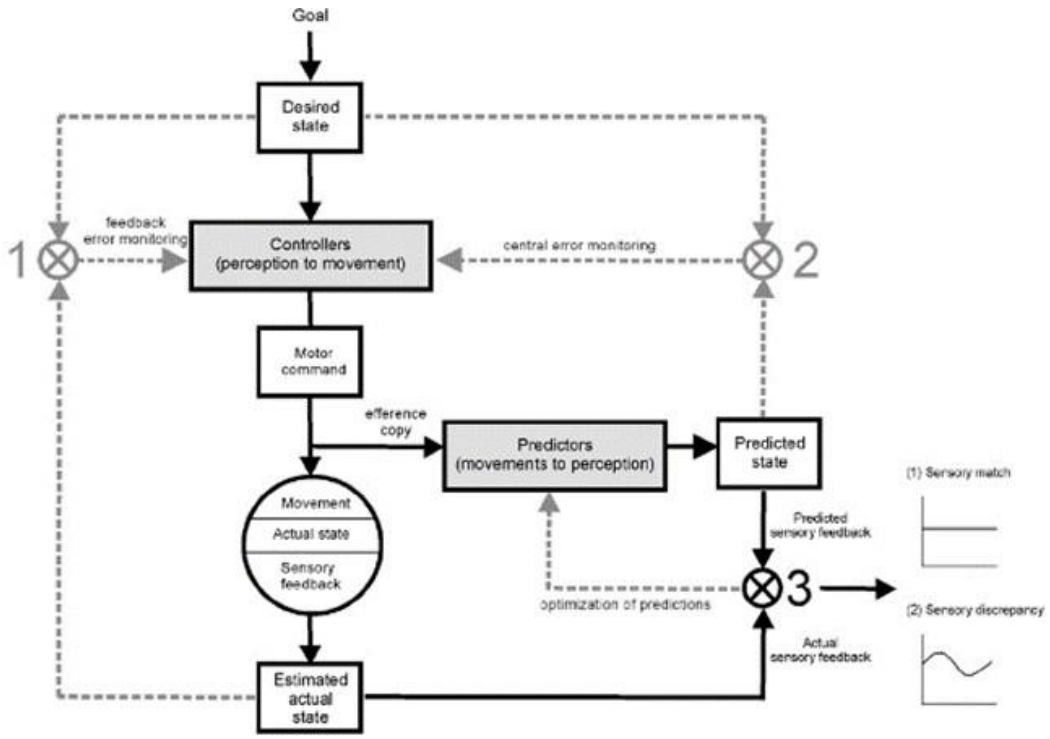


Figure 1. the neurocognitive comparator mechanism underlying the sense of agency [4].

The study of agency is also quite a complex task as there remains no objective manner of understanding the allocation of such a subjective experience. This makes a hard task out of measuring the parameters and extent of the cognitive processes that underlie construction of agency.

Language shapes the way we think. Lera Boroditsky's phenomenal work in the field of cognition and linguistics aims to infer the relationship of language with the cognitive processes that underlie our behaviour. On a perfunctory and basic level, the function of language is to provide structure to our thoughts, but on a deeper and more complex platform, we have come to realize that language just about shapes all our cognitive functions, especially those involved in higher order functioning. Literature establishes that there lies a significant difference in the allocation of agency in monolingual groups speaking languages of different structures.[5]

Sapir and Whorf presented their work in the field of linguistics wherein they highlighted the theory of linguistic relativity. The theory states that our understanding of the world around us is deeply situated in the structure of the language in which we dominantly communicate. This has quite vigorously initiated the debates regarding creation of languages where new

and improved ways of thinking could be introduced but what remains is understanding the basic groundwork of the Whorfian hypothesis a bit better. This would require insight into the patterns of language as utilized for description, with meaning making as the frame of the action. Meaning making in itself is a component of the cultural aspect of language and hence, provides us with the patterns present in the usage of language as a means of appraisal. The structure of languages dictates what the focus is laid on and thus, with that notion in mind, we progress with this study.

The two theories above state establish that agency cannot be perceived as an isolated event. One study explored the effect of aroused affective states on an individual's sense of agency.[6] They found that with fear and anger being the affective states aroused, one reported lowered sense of agency. Fear and distress are also the main components of anxiety, thereby indicating that there should be an altered state observed. On studying explicit or subjective judgements of agency and implicit or sensorimotor agency, it was discussed that cultural cues do in fact alter explicit sense of agency whereas the altered rate of implicit agency cannot be conclusively tied to the same as it could be observed on account of previous exposure.[7] It allows for future researchers to find and locate the correlation between the two with remarks from the authors regarding gaining a deeper insight into the effects of culture on implicit sense of agency as well.

The adoption of intentional binding as a measure of sense of agency with regards to external circumstances lies in the study that concluded that for self-generated motoric actions with consequences in the external world, intentional binding displayed marked results.[8] The impact of intentional binding effect along with auditory cues was seen and confirmed by studies such as those done by previous experimental undertakings examined the effect of congruency between actions and outcomes and deduced that retrospective and prospective cues have a significant impact on the feeling and judgement of agency seen via the intentional binding effect.[9][10]

The review of literature allows us to notice the pre-existing theories of contextual impacts on the sense of both explicit and implicit sense of agency. It allows for the generation of queries such as its impact in individuals with psychological symptoms which alter the internal psyche of the individuals. A study similarly looked into the reduction in sense of agency in patients of schizophrenia displaying predominant negative symptoms and concluded that there was, for the first time, reported reduction in the sense of agency in those patients. In the light of such findings, this study too shall be carried out.

Research Questions

1. Is there a difference in sensorimotor agency within the two groups of individuals with high and low anxiety?
2. Is there a difference in constructed agency within the two groups of individuals with high and low anxiety?
3. How is constructed agency seen in individuals with higher and lower intentional binding as measured by the LabClock Web Test?

Hypothesis

1.H•••0: There is no significant difference in constructed agency between the groups with high and low scores on the BAI.

Ha•: There is a significant difference in constructed agency between the groups with high and low scores on the BAI.

2.H•••0: There is no significant difference in sensorimotor agency between the groups with high and low scores on the BAI.
Ha•: There is a significant difference in sensorimotor agency between the groups with high and low scores on the BAI.

Operational Definitions

1. **Constructed agency.** A causal agent that refers a "context-dependent construct" to the estimation of control in the given situation.[5] It is not an objective judgement but rather a conclusion reached by the participant on the basis of their pre-existing beliefs, past experiences, their current affective states and is therefore a subjective appraisal of the presented stimuli. For the purpose of this study, agency will be analyzed on the basis of assigning intentionality and accidentality, interpreted via descriptors used in the responses of the participants. This is a dependent variable.
2. **Sensorimotor agency.** the feeling of generating actions based on the action-outcome congruence. [11] The pre-existing theory suggests that a motor action is carried out by the sensory feedback provided by the preceding motor movement. The preceding motor movement, in a way, acts in a predictive manner to allow for efference copies to plan the following upcoming movements. Sensorimotor agency thus relies on a spatio-temporal prediction generated by the continuous or uniform pattern of the preceding events. This sense of agency shall be measured by the intentional binding paradigm. This is a dependent variable.
3. **Intentional Binding.** Intentional Binding is the temporal bias witnessed when the effect of an action creates a perception of the following effect preceding the action. It is an implicit measure of agency.
4. **Anxiety.** The presence of anxiety shall be measured using the Beck's Anxiety Inventory. [12] This is an independent variable. The scoring that shall be followed is: 0–7: minimal, 8- 15: mild, 16-25: moderate and 26-63: severe.

METHODOLOGY

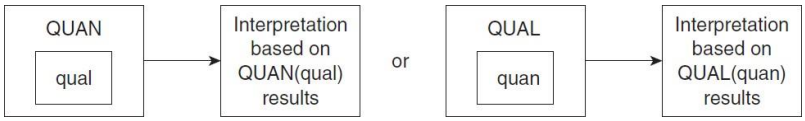
Sample

The population consists of individuals from 18-30 years of age. The sample was obtained by the means of convenience sampling will be stratified random sampling. Inclusion criteria entailed bilingualism or fluency in speaking at least 2 or more languages and an education level of the 10th grade or above.

The exclusion criterion covered visual impairment, language disorders and neurodevelopmental disorders. Informed consent was obtained prior to the experiment.

Research design

The study was a two group randomized experimental design and was conducted as an embedded mixed methods study where the first part was a quantitative analysis using the intentional binding paradigm and the second was a qualitative analysis. An embedded mixed methods research design allows the researcher to apply one design, here qualitative, as a supportive secondary aspect of the study. This secondary role rests primarily on the data provided by the primary design, here, quantitative.



Tools used

1. **Beck's Anxiety Inventory:** The BAI is a 21 item self report questionnaire developed by Aaron T. Beck and his colleagues in 1988 with revisions made in 1993. Research has demonstrated that the BAI had high internal consistency with a Cronbach's alpha of 0.94 and good reliability of 0.67.[13] It is also proven to have good concurrent validity with other scales of anxiety.[14] The scoring is as follows: 0–7: minimal, 8-15: mild, 16-25: moderate and 26-63: severe.
2. **Visual Stimuli:** the visual stimuli presented to the participants will be a replication of the methodology used in a previously conducted study on constructed agency. [5] This methodology involves viewing videos of intentional and accidental unique events and providing descriptions for the same. The videos were 22 in number. The study is not wholly replicated since the elements that measure eyewitness accounts have been omitted.
3. **LabClock Web Test:** The LabClock is a procedure that examines "subjective sense of agency, action-effect binding, and subjective timing of conscious decisions and perceptions.".[15] It is an open-source tool that is based on the Libet Clock paradigm. The advantages of this tool lies in not only that it is an open source tool but also that its construction allows for its conduction to take place online, thereby making it easier to access and implement. This was especially selected for that very reason, keeping in mind the current context of the global pandemic.

Procedure

There was voluntary participation from students of Christ (Deemed to be University) as well as an online call for participants. The consent form as well as the BDI was shared and the participants filled those forms. The participants then took the LabClock Web test to determine their sense of agency via the intentional binding or the "action-effect paradigm" and their results were recorded.

Six participants completed the qualitative phase as well but one was excluded since there were technical errors found during the analysis. The qualitative phase included presentation of task stimuli, the videos of the accidental and intentional scenarios via a laptop screen, following which they were asked to provide verbal descriptions after each video. The responses were recorded via a simple phone voice recording system, with prior participant permission received as required.

RESULTS

The hypothesis under testing includes examining the difference in the construction of agency in people with low and high scores on the BAI. The second hypothesis examines the correlation between the construction of agency and sensorimotor agency as recorded via the LabClock test.

Quantitative Analysis

Table1. Descriptives

	AGE	JUDGEMENT
N	40	40
Missing	1	1
Mean	23.4	-584
Median	22.0	-530
Standard deviation	2.40	539
Minimum	21	-1799

Maximum	29	265
Skewness	1.43	-0.634
Std. error skewness	0.491	0.491
Kurtosis	0.738	0.499
Std. error kurtosis	0.953	0.953
Shapiro-Wilk W	0.740	0.947
Shapiro-Wilk p	< .001	0.279

The analysis studies 22 participants (n=40) from the ages of 21-29. None of the participants were excluded from the study.

The variable of judgement here is the temporal binding effect as calculated using the LabClock Web test.

The mean age of the participants is 23.4 with (SD = 2.40, $p < 0.001$). The variable of judgement is not normally distributed ($p < 0.279$) and hence non- parametric tests were carried out for further analysis.

As a baseline analysis, we saw that the data was neither statistically skewed nor did it exhibit kurtosis. The ages of the participants however display high skewness and can hence be discussed further as the study is completed and full results have been evaluated.

Table 2. Independent Samples T-Test

		Statistic	**p**
JUDGEMENT	Mann- Whitney U	55.0	0.771

The ($p < 0.771$) indicates that no significance effect is present. The null hypothesis is thus accepted that no significance relationship lies between the level of anxiety and temporal binding effect in young adults with anxiety.

Table 3. Correlation Matrix

		JUDGEMENT	**ANXIETY RATING**
JUDGEMENT	Pearson's r	—	
	p-value	—	
ANXIETY	Pearson's r	-0.248	—
RATING	p-value	0.266	—

Note: a value of -0.248 indicates a low negative correlation between the two variables.

The above analyses were conducted on the Jamovi software. [16][17]

Qualitative Analysis

The qualitative analysis was carried out by two raters, the author and an external, to ensure validity and reliability of the coding.

Cohen's kappa was calculated using the SPSS software.

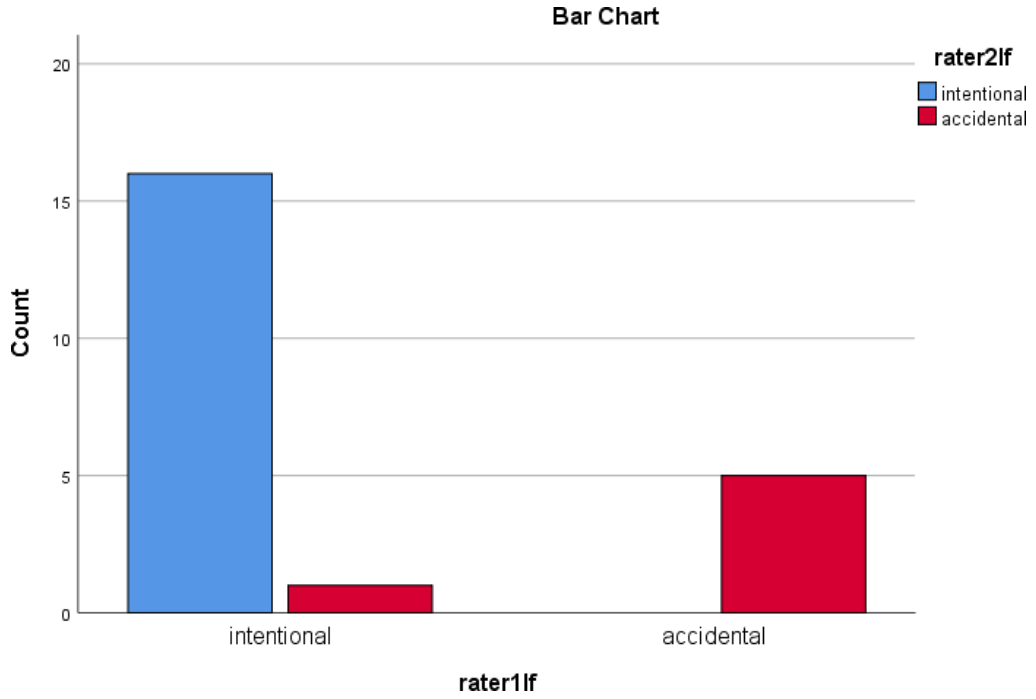
Symmetric Measures

		Value	Asymptotic Standard Error[a]	Approximate T[b]	Approximate Significance
Measure of Agreement	Kappa	.879	.117	4.154	.000
N of Valid Cases		22			

a. Not assuming the null hypothesis.

b. Using the asymptotic standard error assuming the null hypothesis.

The kappa value was calculated as 0.979 indicating a high inter-rater reliability.



DISCUSSION

The data so far indicates that anxiety levels do not significantly influence sense of agency (SoA) in individuals. A study observed interesting results when they attempted to study intentional binding across the lifespan of individuals.[18] In the three groups they studied, children, young adults and elderly people, it was the first and third group that showed a reduction in IB, which the researchers hypothesised could be on account of the variation of inhibitory control seen in these populations. This can be fairly attributed to the difference in frontal areas seen in these groups. However when exploring the reasons for the results observed, a study where parallels may be drawn is one that looks at the experience of being an intentional agent as a component of personal autonomy and concludes that there are no indicators of objective aspects of one's personal autonomy influencing intentional binding.[19] Similarly another study found that both explicit and implicit measures of agency, though measured differently based on the free and forced choice paradigm, are based on different processes.[20] This is relevant to our study primarily because it challenges the notion of intentional binding as a paradigm to study autonomy and hence its entire relevance in terms of the position it holds in different psychopathological disorders.

The results of the qualitative analysis lead us to understand that the actions were perceived as being more intentional rather than accidental. There could be various reasons for that, the

first that the visual stimulus created for the purpose of this study was insufficient in generating the distinction between intentionality and accidentality as required, thereby inclining all responses in one orientation or the other. The other reason can be studied via the lens of the applied emotional valence in each of the videos. This was studied in detail by a group when they examined the role of emotional valence in conjunction with action binding and responsibility.[21] It utilised various auditory tones of positive and negative valence in view of their effects on prospective and retrospective action binding. One of the many conclusions they reached signified that retrospectively, experiences of agency were highly motivated by emotionally driven contexts rather than neurocognitive mechanisms that may have initially been the operational force. A reduced feeling of responsibility overall allows them to assign intentionality rather liberally than not.

The qualitative study was done on both people with high and low scores on the scale of anxiety. Overall higher frequency of intentionality as observed in the actions of other people was observed and along with the previous deductions, these results can be further elaborated in the light of the study that found that intentional binding and self transcendence, described as the awareness of being alive and responsible for one's actions and their role in society, were significantly correlated.[22] This finding was explored as an evolutionary understanding of human behaviour and the progress of social cognition herein. An aspect that can be taken into consideration is the vast number of studies done on individuals' internal locus of control. This however is not something that can be significantly understood through this study but by providing future qualitative exploration of the same, we can better comprehend its implications.

A very important piece of literature emerges from works on the Theory of Mind or ToM by Karl Friston. Research highlights the role of interoceptive inference in ToM as established through neuronal hierarchies of exteroception, proprioception and interoception which further include sensorivisceral, sensorimotor and visceromotor levels that help dictate prediction/expectation and prediction errors.[23] Ondobaka et al (2017, p. 67) state, "Most current social cognition models suggest that exteroceptive (e.g. visual and auditory) and proprioceptive (i.e. motor) processing underlie inference about intentional and emotional states. Embedding interoception in a multimodal active inference framework may offer a more complete and plausible model of ToM. This extension may also provide a principled account of ToM that appeals to a sense of agency and selfhood – and that is equipped with the interoceptive aspects of affect and feeling states.". Their study adds to a better conceptualization of the role of explicit and implicit agency in pathological conditions.

The limitations of this study include a small sample size as a larger sample of around 120 people would be more sufficient. Similarly, a better qualitative research design would provide a more conclusive deduction of judged or constructed agency in the participants.

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Conflict of Interest

The author(s) declared no conflict of interest.

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