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Conceptualization of a Heuristic to Predict Increase in Restricted and Repetitive Behaviour in ASD across the Short to Medium Term

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Abstract

Restricted and repetitive behaviors (RRBs) are central to the diagnosis of Autism Spectrum Disorder (ASD), yet there is a paucity of research in this domain. Despite the lack of conceptual clarity, and related empirical findings to underpin practice, clinicians are called on to not only diagnose people with ASD, but also to make prognostic predictions across the short to medium term. These prognostic decisions impact the interventions selected and access to programs. This paper synthesizes available evidence to inform a model of repetitive patterns of thought, ritualistic behaviors and insistence on sameness, arguably the cluster of behavior most likely to be seen in main stream clinical settings and schools and design a heuristic that could be applied by clinicians to aid prognostic decisions and form the basis of further research eventually leading to actuarial models.

Keywords: Autism; ASD; Dynamical systems; Restricted and repetitive behaviors; Heuristic

Introduction

Restricted and repetitive behaviors are central to the conceptualization of ASD as a disorder and its diagnosis. Despite the centrality of these behaviors to our contemporary picture of ASD compared to the other pillar of the dyad that forms the diagnostic concept that of impaired communication and social skills, little is known of this domain. It would appear that RRBs are a heterogeneous entity in terms of, not only type of behavior and thinking described, but also the mechanism of action underpinning them. While clustered together it is emerging that plausibly repetitive sensory motor behaviors or stereotypic behaviors, are separate in function and have different underlying mechanisms or causative factors to repetitive patterns of thought, ritualistic behaviors and insistence on sameness. Despite the paucity of knowledge school nurses, as part of the individual education program teams are called on to make short term prognostic decisions. A scoping review was conducted to inform the development of a heuristic to assist school nurses in organizing the required information to allow decision making [1].

Method

The search terms: Autism, Autistic Disorder, Asperger's Disorder, Autism Spectrum Disorder were combined in an iterative manner with restricted and repetitive behavior, obsessions, rituals, stereotypic behavior and insistence on sameness and searched in the databases Medline, PsycINFO info and Cinahl for the years 2000-2015. Abstracts were reviewed to identify studies of restricted and repetitive behavior of people with ASD. Studies that did not explicitly identify participants with autism, ASD, Autistic Disorder or Asperger's Disorder were excluded from the review. A further review was conducted on prediction of behavior and development of heuristics in the same journals to inform the narrative synthesis.

Restricted and repetitive thought and behaviors

The triad of impairment that underpinned the evolution of the diagnosis of autism in the American Psychiatric Association Diagnostic and Statistics Manual (DSM) up to the DSM IV TR was replaced by a dyad of impairment in the DSM-5 [2]. The three factors inherent in the diagnostic concept collapsed to two. Impaired communication and social skills were clustered as one part of the dyad and RRBs form the second part of the dyad in the latest version. Despite the centrality of RRBs to diagnosis there is a paucity of research in this domain [3-5]. Little is known of how RRBs change over time as people with ASD move through childhood into adolescence and adulthood [6,7]. Longitudinal studies are sparse and findings varied [5]. What is clear is that RRBs present extreme challenges to people with ASD, their parents and caregivers [3,8]. This challenge is not only manifested in the present, but may also be projected into future development, as RRBs not only inhibit adaptation in the present but through impaired flexibility and openness to environmental cues also impact on development of future capabilities [3,5,9,10].

Measurement of RRBs

Measurement of RRBs is currently hindered by the lack of conceptual clarity. In a review of the small number of studies on RRBs Honey et al. [4] identified that, "most measures have been used relatively infrequently, making it difficult at this time to undertake a fair review of their strengths and weaknesses". Measures have been hindered by the need to capture all the varied dimensions included under the banner of RRBs. While the debate continues in the literature as to the nature of this multidimensional construct [4] a plausible model is the division into two main entities. The first entity being sensory motor repetitive behaviors (stereotypic behaviors) and the

second repetitive thought (obsessions), rituals and insistence on sameness [11]. This is not a retreat to the separation of thought and behavior, as the later come with their own characteristic behaviors. The relative lack of research investment beyond childhood for ASD related projects [12] has inhibited the knowledge of evolution of RRBs in people with ASD over time. Clustering of both entities in the same tool, which is common, may well be the result of thinking focused on early childhood where both clusters are observed, and the age group where the bulk of research investment has occurred.

Repetitive sensory motor behaviors (stereotypic behavior)

Repetitive behaviors and insistence on sameness feature in typical development in young children [7] and other developmental disorders [13] and are not behaviors unique to ASD. It would appear that as cognition develops sensory motor repetitive behaviors become less common and in typical development rarely last beyond four to five years of age [7]. Repetitive sensory motor behaviors appear to remain prevalent beyond entry to school in people with ASD who have comorbid intellectual disability, with the distinguishing factor being related to cognitive development [6,3,11]. The underlying mechanisms of these sensory motor repetitive behaviors appear to be related to self-stimulation and sensory under responsiveness [13]. It has been reported that in children with ASD and no comorbid intellectual disability that stereotypic behavior observed in preschool often shifts to obsessions and rituals, with insistence on sameness remaining once the child hits school age or soon after [10]. Obsessions, rituals and insistence on sameness that manifest as marked inflexibility of behavior are common traits seen in people with ASD presenting to mainstream mental health services and in mainstreams schools. These behaviors are the cluster of RRBs referred to in the remainder of this paper.

Prediction of behavior

Future prediction of other's behavior is an integral part of neurotypical thought and judgment. "There is nothing alien about using predictions of the future behavior of others to guide our conduct; it is hard to imagine life without assumptions of the continuities and discontinuities in the behavior of others and without reliance on such assumptions" [14]. Such prediction is used in daily tasks like crossing the street or driving a car. Clinicians are commonly called on to make prognostic judgments about likely future behavior as part of their practice. A common example of such judgment, related to work with people with ASD, would be decisions related to the need for extended school programming made by the individual education program team each year [15]. The judgment/prediction needs to be made to secure the option of extended programming. The judgment entails the prognostic decision as to whether without such extended programming across the long summer break significant regression and loss of learning would occur, or a prolonged period of impairment be seen before adaptation to the demands of the new school year [16]. Such consideration is proposed to be included in a student's Individual Education Plan (IEP). From the limited research available it has been identified that, "many IEPs may be lacking in their consistency with recommended practice" [15].

Prognosis is a different process to diagnosis, in that unlike diagnosis where an individual's behavior, based on available data, is fitted to common patterns seen in relevant diagnostic classification systems, in prognosis the clinician is called on to predict future behavior or outcomes. In both diagnosis and prognosis a decision needs to be made, but the data available to the clinician differs [17,18].

Anamnestic, actuarial and clinical judgements

An extensive literature has developed around clinical prognostic judgments. The focus has been varied, but in the domain of mental health a large weight of it has been in the area of predicting dangerousness. The three main types of prognostic judgments typically discussed are actuarial (based on statistically weighted variables), anamnestic (based on past history of behavior in similar circumstances) and clinical judgments (judgment by clinician based on individual interpretation). Actuarial judgments often include an element of anamnestic prediction.

From the late 1980's it has been identified that actuarial and anamnestic prediction are relatively reliable as compared to clinical judgment [14]. By 1989 it was identified that there were nearly 100 well-constructed and executed comparative studies in which actuarial and clinical judgment was contrasted and that, "in virtually every one of these studies, the actuarial method has equalled or surpassed the clinical method" [19]. Actuarial judgment involves interpretation based on empirically established factors relative to the decision, and the human judge (clinician interpretation) is removed, as the finding is automatic [19]. Variables, based on their predictive power, contribute to the decision [20]. Actuarial tools often consist of dynamic and static factors [21]. Anamnestic prediction is often a static factor in actuarial tools and is related to how a person has behaved in a similar context in the past, as a factor of their personal history. "There is no doubt that inclusion of past behavior improves the prediction of future behavior" [22]. Large scale reviews of the literature have consistently found past history of behavior to be a significant factor in predicting future behavior [21-24].

Clinical judgment often includes similar factors to those dynamic and static factors that form the base of the actuarial models, but the clinician relies on their personal judgment to assimilate the data and reach a conclusion [14,19]. "Clinical judgment is defined as judgments in which the inference or weighting is done by the human judge" [18]. The human judge (individual interpretation) element of clinician judgment has been found to be the unreliable factor that has contributed to the documented superiority of actuarial methods. Cognitive bias is a commonly identified factor where clinicians incorrectly weight data based on perceived clinical salience arising from clinician history [20]. This weighting is based on their n=1 experience. Expertness was conceptualized as existing within the human judge represented as intuition [25]. However this thinking has since been revised and a more analytic process of decision making championed [26].

The clinical world rarely contains all the elements necessary to allow actuarial decision-making. The clinical world is often congruous with the concept of large worlds [17]. Large worlds are, "a situation in which some relevant information is unknown or must be estimated from samples and the future is uncertain, violating the conditions for rational decision theory" [17]. In terms of RRBs there is a paucity of research, so the empirical data does not exist to construct an actuarial model. In fact consensus on the conceptual construct remains to be achieved [4]. Yet clinicians have been making prognostic decisions and will continue to be called on to do so in the short term in the domain of RRBs. These decisions are high impact in terms of service access and intervention choice. Yet the limited research that is available would suggest that when happening the decisions lack the consistency of

approach that would be expected in the context of high impact decision making [15].

Heuristics

In a world in which we are constantly bombarded in our wakened hours with sensory information neurotypical thinkers (people without ASD) form schemata (mind maps) that allow decision making by honing in on salient information [27]. These schemata or heuristics allow an economy of thought, as in the act of honing in on, or focusing, on salient information, part of the available information is ignored [17]. This is the act of the human judge referred to in the discussion of the limitations of clinical diagnosis. Such heuristics are often implicit and over time slip below conscious awareness as the situation becomes familiar (think about leaning to drive). In many cases they can be formed on the basis of an inaccurate notion of salience and weighting of cues [20]. However, formalized heuristics, based on careful consideration and design can, "help bridge the clinical-actuarial divide that is they can be developed into actuarial methods that are both accurate and easy to implement by the unaided clinical judge" [18]. The heuristic developed is based on a plausible and functional model of the phenomena or clinical judgment [17,18]. "A heuristic is functional, not a veridical (true or exact) copy of the world" [17]. These simple heuristic models have the advantage of being explicit which allows consistency and facilitates academic discussion and refinement through research. Heuristics, as plausible models of clinical judgments, have been shown to in some cases not only equal actuarial judgment, but to outperform them [18,28]. Once developed heuristics can be taught and applied in practice with good success [28]. To be effective a heuristic needs to ecologically rational, in that it matches what is known of the structure of the behavior in the form of tendencies and patters [28]. The heuristic also needs to be frugal, that is relying on as small a number of cues as is possible [17,18].

No published heuristics to aid clinicians in the task of prediction of the trajectory in relation to RRBs were identified in the literature. Due to the paucity of available research to inform cue weighting a tallying heuristic, where all cues are weighted equally [17] is well suited to the design of a heuristic to aid clinical prediction related to RRBs. For this heuristic, in the context of a paucity of empirical findings, it is easy to be frugal. Two dynamic factors have been identified as influential to the course or manifestation of RRBs. These factors are anxiety and the presence of structure in the environment. A static factor that is well established in prediction of behavior is that which forms the basis of anamnestic prediction. This factor is history of behavior in a similar context.

Anxiety

The relationship between RRBs and anxiety has been discussed for some time [5,9,10,13,29-31]. This relationship is particular to the cluster of obsessions, rituals and insistence on sameness [31]. The relationship also appears to be distinct from that experienced in other disabilities [31]. As anxiety increases it would appear that RRBs also increase in children and adolescents [13,31]. In light of the high incidence of the experience of anxiety, to that which meets diagnostic thresholds for disorder, this is a particularly important relationship [32].

Structure

While relatively less investigated than anxiety, and restricted to the domain of children and adolescence, the findings are consistent that structure or scaffolding, in the environment reduces the impact of RRBs on performance [33,34]. In a study of 10 males aged 8-15years in the context of a Lego model building activity Clark et al. found through analysis of recorded activity samples that the impact of RRBs on performance, both task related and interpersonal, is reduced through externally enforced structure [33]. The impact of the RRBs was labeled functional inertness (off task behavior) and it was stated that, "this functional inertness can be intruded upon and more desirable behavior superimposed in relation to both the task at hand and to the presence of another person" [33]. The degree of structure was described as, "the extent to which the objectives of the interaction were explicitly presented to the child and the extent to which the child was allowed to deviate from the route to these objectives" [33].

Pierucci conceptualized structure through the lens afforded by Lev Vygotsky of scaffolding [34]. The goal was stated as aiding the movement from a child's actual development to the proximal zone of potential development through scaffolding or providing structure. Within the limitation of a small sample it was identified through analysis of recordings of play that; "scaffolding during play is an important contribution in spurring toddlers with ASD to reach their full potential" [34].

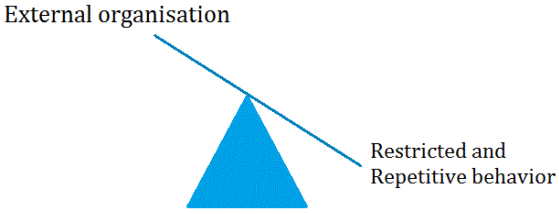

Figure 1: Scale with RRBs tipping down and external organization tipping up.

From the limited research available it would appear that externally imposed structure is a protective factor and that as structure decreases the propensity to engage in RRBs increases (Figure 1). Decreased externally imposed structure is a risk factor for increased intrusion of RRBs.

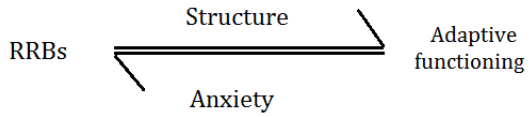

Figure 2: Dynamic factors associated with intrusiveness of RRBs.

It would appear that as anxiety increases so does the intrusion of RRBs. Anxiety is a risk factor for increased intrusion of RRBs. Both anxiety and structure are dynamic factors as they are mutable factors that can form the basis of intervention and they change over time [23]. The aim of intervention would be to increase or maintain a structured environment and to decrease levels of anxiety (Figure 2). The nature of such intervention is beyond the scope of this paper. The heuristic indicates the need and focus for the intervention but not the type of intervention. The static factor that is justified for inclusion in the model is the history of behavior in a similar context. In this case a history of an increase in RRBs in a time of high anxiety, decreased structure or both is risk for this to occur again.

The combination of the dynamic and static factors provides the basis of a tally heuristic. This is frugal as it only has three cues and is ecological as it matches what is known in the clinical environment. It would appear that explicitly exploring the level of anxiety, amount of structure over the coming time in which the prediction is being made and clinical history will deliver, based on the available evidence a plausible data set to predict likely intrusion of, or getting locked into RRBs. This heuristic provides a structure to make an explicit clinical decision. A combination of the risk factor of low externally mediated structure in the presence of either high anxiety, a clinical history of an increase in intrusive RRBs in the context of low structure, or both, indicates the need for intervention. The focus of the intervention would be to alleviate the dynamic risk factors by lowering anxiety and increasing structure (which would not theoretically appear to be mutually exclusive).

The heuristic is:

$\Delta RRB = -E + A + H$

E=Level of external structure

A=Level of anxiety

H=History of level of intrusiveness of RRBs in a similar context,

Decision tree

The tally heuristic could be presented as a simple decision tree (Figure 3).

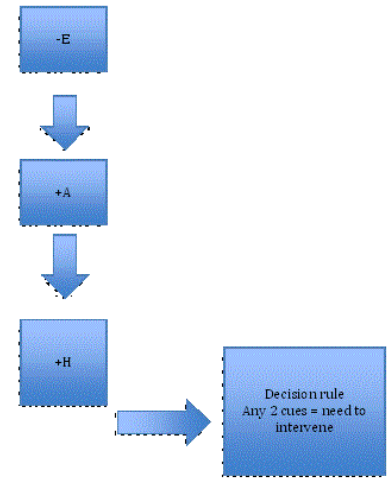

Figure 3: Heuristic decision tree.

Use of the heuristic as a basis of future research

The identified heuristic, as well as having clinical utility as a plausible model in the current large world environment of a lack of available empirical data to build actuarial models and the present need to make bounded decisions, can also form the basis of future research. The heuristic can be used as the basis to establish the weighting of the cues in leading to 'locked in behavior' [35] over time. The proposed differential equation gives a clear direction of a way of moving beyond tallying, to identification of the development of RRBs over time and furthers the differentiation of the relative contribution of the cues/variables in the model.

The quantity t is a measure of time, measured in weeks. The equation designed to describe a model for how behavior changes with time.

Where R, ΔR, E, A and H vary with time and are described below.

R=repetitive restrictive repetitiveness, measured on a scale of 0 to 1, where 0 is totally healthy behavior and 1 is totally locked in behavior.

ΔR=Change in R (per week);

E=Level of external structure (on a scale of 0 to 1);

A=Anxiety (on a scale of 0 to 1);

H=History of how high R has been rescaled to a range of -1 to +1; hence a history of behavior that is well integrated might have H~-1 while a history of strongly locked in behavior would have H~ +1.

R(t) can only rise to some maximum value corresponding to being maximally locked in.

The minimum value of R=0. Maximum value of R=1.

The a, b and c above are constants to be determined which correspond to how quickly ΔR is influenced by E, D and H, respectively. Here a, b and c are positive or 0 and they depend on the individual.

Then the model to identify movement over time is:

$\Delta R(t)=-aE+bA+cH$

This is a simplistic model but it will enable a discussion of the relative importance of influences of changes in R(t) when R is between 0 and 1.

To determine the relative influence of E, D and H

$\Delta R(t)=-a\times E +b\times D +c\times H$ (where×means times).

This will allow progression in the heuristic from tallying to a take the best or weighted model [17].

The evolved heuristic would be

$\Delta RRB=-aE+bA+cH$

E=Level of external structure

A=Level of anxiety

H=History of level of intrusiveness of RRBs in a similar context, a, b and c are constants to be determined

Conclusion

There is a marked paucity of research related to RRBs and a lack of conceptual clarity. It is not clear that existing tools, with the relative influence of childhood and early adolescence in the allocation of research investment [36] are sensitive to capturing the manifestation of RRBs across the lifespan [4]. Despite this lack of clarity clinicians are, and have been for some time, called on to make prognostic decisions re likely intrusion of RRBs on adaptive functioning across the short and medium term, such as the extended summer vacation or in transition periods. A heuristic has the potential to improve the quality and consistency of the decision as it improves on clinical decision making through bridging the divide that exists between clinical and actuarial methods of making decisions [18]. Heuristics can also contribute toward the ultimate development of actuarial models through providing a base to structure research questions [17]. While indicating the focus of intervention the nature of intervention to achieve the necessary outcomes are not dictated. The simple tally heuristic $\Delta RRB=-E+A+H$ is a plausible model that is ecologically rational and frugal. The developed heuristic has clinical utility for making prognostic decisions related to the development of restricted thought, rituals and insistence on sameness that inhibit adaptive behavior. Making the decision explicit allows refinement through academic discourse and research and promotes consistency.

Plausible equations are provided to underpin research to extend the tally heuristic to explore the relative weight of variables and to explore development of RRBs over time. Findings form both research directions will help refine the reliability of prognostic decisions in this domain. A domain that has high impact both for people with ASD and those who care for them.

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