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Empathizing and systemizing skills influence risky decision making in children

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ABSTRACT

Tow-mode theories explain that risky behaviors in young individuals may be the result of competition between an affective system (e.g., Empathizing system) and a deliberative system (e.g., Systemizing system). We aimed to investigate a total of 134 children aged 7–12 years old on scores of risky decision making and empathizing and systemizing measures. The primary analysis indicated that systemizers showed higher sensitivity to punishment than those in balanced or empathizer classes ($F(2,130) = 14.8$, $p < 0.001$). Furthermore empathizers indicated higher level of risk taking than balanced and empathizer children ($F(2,130) = 5.027$, $p = 0.005$). Providing further support for two-mode theories in risky decision making, findings suggest that empathizing and systemizing measures may be useful indexes for addressing affective and deliberative systems.

1. Introduction

Risky decision making and reward seeking displays a typical developmental trajectory which generally peaks in adolescence and is comparatively lower in childhood and late adulthood (Figner, Mackinlay, Wilkening, & Weber, 2009). Findings show that poor decisions or everyday risky behaviors in children or adolescents can have negative lifelong consequences (Prencipe et al., 2011). In spite of a growing literature investigating different behavioral and cognitive impairments as precursors of risky behaviors, the picture is not yet clear particularly in young individuals (Romer et al., 2009). Shedding some light on processes involved in risky behaviors particularly in adolescents, two-mode theories has been recently used to explain that a risky behavior is the result of competition between a phylogenetically older dominant affective system and a younger deliberative system (Evans, 2011; Figner et al., 2009; Steinberg, 2008). According to this model, affective processing is intuitive and spontaneous and biases the behavior through affective impulses while deliberative processing is controlled and effortful and forms the behavior based on rules of logic and abstract reasoning (Pretz, Totz, & Kaufman, 2010; Reyna & Brainerd, 1995; Rivers, Reyna, & Mills, 2008; Weber, Shafir, & Blais, 2004).

In evolutionary perspective, affect is a crucial input in decision making process since it allows optimal decisions to be made in uncertain, time limited environments (De Martino, Kumaran, Seymour, & Dolan, 2006). However, in the presence of strong affective system, individuals often behave myopically (They attempt to satisfy short term gratification with little or no attention to long term consequences) (Loewenstein, 2005). Affective system contributes to a larger social cognitive concept called empathy which encompasses a wide range of social and emotional processing (Bohart & Greenberg, 1997).

Empathy refers broadly to the ability for understanding what others feel (cognitive empathy) and to respond them emotionally and appropriately (affective empathy) (Singer et al., 2004). Empathy is rather considered to be an automatic, subconscious response that is processed by emotional and affective intuition and involves little deliberation (Greene & Haidt, 2002). Thus empathizing or feeling empathy along with a number of cognitive and affective aspects of social interactions may changes the preferences during decision making (Hakansson & Montgomery, 2002; Loewenstein, 2005). However deliberative system may be assumed to counterbalance the empathy system.

In recent years, studies have examined this dichotomous paradigm using a neurodevelopmental approach, enrolling individuals with specific neurological conditions namely autism spectrum disorders (ASDs) (Evans, 2011). Rather than healthy people, individuals with

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ASD and those with autistic traits frequently show extreme deliberation but deficits in empathy system. De Martino et.al has recently proposed that individuals with ASD make much more deliberative than intuitive decisions (De Martino et al., 2006). This finding appears to be in parallel with empathizing–systemizing (E–S) theory of autism. E–S theory explains that social cognitive deficits in individuals with ASD are due to the imbalance between their empathizing and extreme systemizing abilities (Baron-Cohen, 2010). Although origin of theory lies in research on autism, a number of researchers argue that E–S model has the illustrative power to explain cognitive style differences even in general population (Wright & Skagerberg, 2012).

Baron-Cohen, Richler, Bisarya, Gurunathan, and Wheelwright (2003) defined the brain types based on an interaction between empathizing and systemizing abilities. They identified a condition in which individuals have high empathizing and low systemizing (female brain); a reverse condition in which individuals show high systemizing and low empathizing (Male brain); and finally a condition of balanced empathizing and systemizing (balanced brain). They proposed that although most people with normal functioning poses the balanced brain; there are individuals at the extremes may show pathological cognitive functioning. When systemizing dominates, brain has a bias to analyze, deliberate and control systems via the identification of rules which govern the system (Wheelwright et al., 2006). There are two possible underlying mechanisms that might be responsible for effect of systemizing on decision making or risk taking. Processing information analytically and logically based on the rules of the context, makes individuals more sensitive to the complex effects of a risky decision (Weber et al., 2004). Particularly after a punishment, the negative decisional balance can influence the way that individual make a decision (Figner et al., 2009). Another mechanism is related to the inhibitory role of systemizing against the affective (empathizing) system that enables making deliberative decisions even in emotionally primed situations (Cohen, 2005; Knoch & Fehr, 2007). It can be hypothesized that while empathizing skills make the affective system as the area of strength in decision making processes, systemizing try to move system to deliberation and conserve system from the negative consequences related to an affective decision making.

Given together to examine if the E–S theory may replicate two-mode theories in risky decision making, we aimed to investigate how children with a variety of empathizing–systemizing abilities make a risky choice and are sensitive to its negative consequences. Our main hypothesis was that higher scores in empathizing ability are correlated with higher risk taking. On the other hand, dominant systemizing cognitive style that is associated with more deliberative and strategic decisions, results in less risk taking. In that vein, individuals with higher empathizing would show lower sensitivity to negative consequences of risk taking but those with higher systemizing skills would be more sensitive to negative punishments of a risky choice.

2. Methods

2.1. Participants

A total of 134 children aged between 7 and 12 years old were recruited from two community schools in Tehran. The participants in this study were considered to characterize a typically developing sample, as none of the participants represented any mental or physical impairment. Furthermore, considering the risk related activities as a male typical behavior and the fact that males may be more exposed to negative consequences of risky decision making; boys are the participants for this study. Participants came from primarily Iranian middle income families. The child's parent or caregiver completed written informed consent and the child assented to assign to the study. The study was approved by the Medical Ethics Committee of Tehran University of Medical Sciences.

2.2. Procedure

Participants were tested individually in a quiet room. There were skilled experimenters in class that clarified the requirements and test instruction for each child before the test session. Each session lasted approximately 60 min; the tasks were administered in a same order for participants.

2.3. Measures

2.3.1. Risk taking and sensitivity to punishment

The propensity of risk taking was assessed by the Balloon Analogue Risk Task (BART), a computer program in which risk is beneficial to a point and higher level of risk taking results in disadvantageous consequences (Lejuez et al., 2002). Participants were encouraged to earn the most possible money by pumping up a series of 30 balloons one after another with varying explosion points. The balloon was pumped up a little more by pressing a button and 5 cent was saved to a temporary bank by each click. If participants pumped up a balloon beyond its explosion point, the balloon would explode and the money in the temporary bank was lost consequently. However, if participants press a button labeled “collect $$$” before the explosion point, the money earned for that balloon was saved to a permanent bank. The standardized total scores were recorded for total earned money, total number of exploded balloons (Pop number) and particularly the average number of pumps in non-exploded balloons (Pump number) that according to Lejuez et al., the latter would reflect the risk taking (this variable was called “risk taking” in this study). We further examined the sensitivity of participants to risk consequences by assessing sensitivity to punishment. For every exploded balloon, we subtracted the number of pumps made on the balloon trial immediately following the exploded balloon from the number of pumps made on the trial preceding the exploded balloon. Positive values indicate that participant makes fewer pumps on the subsequent balloon whereas negative values indicate that s/he makes more pumps following a balloon explosion. Then an average of difference scores across the task was reported for each participant. Indeed, the reduction in pumps following balloon explosions could be interpreted as an indicator of sensitivity to negative punishment (Humphreys & Lee, 2011).

2.3.2. Empathizing–systemizing skills

Child version EQ (EQ-C) and SQ (SQ-C) were used in children. In order to prevent child possible mistakes related to reading and comprehension skills, the questionnaires were filled out by child's parents or caregivers (Auyeung et al., 2009; Ghanouni et al., 2015). EQ-C (27 items) and SQ-C (28 items) combined into one questionnaire (a total of 55 questions) and were used to examine empathizing-systemizing cognitive styles in children aged between 4 and 12 years old. Each question has four alternatives: ‘definitely agree’, ‘slightly agree’, ‘definitely disagree’ and ‘slightly disagree’. Parent or caregivers indicate how strongly they agree/disagree with each item about their child. For the EQ-C, ‘definitely agree’ scores 2 points, ‘slightly agree’ scores 1 point and both response of ‘definitely disagree’ and ‘slightly disagree’ response scores zero point. However there were some reverse scored items and the maximum achievable point for this domain was 54. For SQ-C, the scoring was similar to above but the maximum achievable point was 56.

Furthermore to obtain an index of children relative ability to empathize or systemize, we calculated ‘brain type’ for each participant using a previously published method by (Wheelwright et al., 2006). SQ-c and EQ-c scores were normalized using the following formulae: $S = (SQ\text{-}c - Mean) / 56$ and $E = (EQ - Mean) / 54$. Mean represent average of typically developing children EQ-c ($M = 37.70$; $SD = 9.81$) and SQ-c ($M = 24.11$; $SD = 8.02$) (Auyeung et al., 2009). The new E and S variables were used to create a difference score ($D = (S - E) / 2$) for each child. To specify the brain types on the “D” scale, children in the lowest