

Influence of Visual Imagery Ability on Level of Empathy in Adolescents

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Abstract

Empathy is a poorly defined concept, but after decades of research it has been described as being able to feel, share, and understand the feelings of another person while realizing the source of the emotion isn't from oneself. Many factors affect empathy, including visual imagery ability which is defined as the ability to see representations of an object in your mind's eye without having the object in front of you. We hypothesized that visual imagery ability will have a positive correlation with one or more aspects of empathy in adolescents. In Phase 1 of the study, the Vividness of Visual Imagery (VVIQ) questionnaire) was administered to 110 students (grades 10-12). Based on their scores, participants were divided into 3 groups; hyperphantasic (VVIQ score 16-32), typical (VVIQ score 33-74), and hyperphantasic (VVIQ score 75-80). In Phase 2 these 3 groups were assessed using the IRI (interpersonal reactivity index). A Pearson Coefficient Correlation test was used to examine if there was a correlation between any of the IRI subscales and VVIQ scores. We found a positive correlation between the fantasy subscale of the IRI and VVIQ scores in adolescents. There was a slight negative correlation between IRI-PT, IRI-EC, and IRI-PD that was not statistically significant. This data supports the conclusion that IRI-FS may be measuring visual imagery ability rather than empathy ability. IRI-FS may be acting as a catalyst for other emotional outcomes in adolescents.

Introduction

Empathy is a poorly defined concept that many consider to be part of the human condition. Extensive research through many years has allowed scientists to compile the key components of empathy. Eklund and Meranius combine these characteristics well into one concise definition; "Empathy is to understand, feel, and share what someone else feels, with self-other differentiation" (Eklund and Meranius, 2021). These four key characteristics are what make up and determine if a person is feeling empathy. Out of these characteristics, feeling and sharing are considered traits of a type of empathy called affective empathy. This type of empathy is considered to be the automatic emotional response to another's emotional state. The other characteristics, understanding and self-other differentiation, are traits of cognitive empathy. This type of empathy consists of the analysis and interpretation of another's situation while knowing that the origin of the emotion is not from yourself (Eklund and Meranius, 2021). Both of these types of empathy are crucial for forming the complete whole that is empathy. These different aspects of empathy are located in regions throughout the brain, including the bilateral dorsomedial thalamus, midbrain, medial orbitofrontal cortex, dorsal anterior cingulate cortex, anterior mid cingulate cortex, supplementary motor area, and bilateral insula (Gonzalez et al., 2013).

Evolutionarily and historically, empathy has allowed humans to secure their survival in the wild (Gonzalez et al., 2013). As our ape predecessors evolved to have more complex social structures, empathy emerged. Today empathy serves as a skill to connect with other humans, whether it is family or strangers. Empathy deficits found in autism spectrum disorder, psychopathy, and antisocial personality disorder all have been linked with difficulty forming social bonds (Gonzalez et al., 2013). Many of these empathy deficit disorders start in adolescence as it is a time of critical empathy development. Some of these empathy deficits are

genetic, but childhood experiences may affect the impact the deficit has on the adolescent. Without the proper parental behavior in childhood, prosocial behavior may not develop leading to these empathy deficits (Gaspar and Esteves, 2022).

From childhood a person's experiences and genetics shape who they are and how they are affected by certain events. And like many aspects of the human condition, there are many factors that affect how empathy manifests in a person. But the main factors are genetics and life experiences. Life experiences and contextual factors will dictate who or what you feel empathy for while genetics dictates the extent you feel empathy (Cuff et al., 2014). Age also has a large impact on how a person experiences empathy as throughout different developmental stages they will experience it differently. During the teenage stage of a person's life, depending on gender, they will experience an increase or decrease in empathy compared to the rest of their life (Gaspar and Esteves, 2022). Additionally, culture affects how a person experiences empathy as different cultural teachings will affect the moral views of an individual. Studies researching the link between culture and empathy are hesitant to say that people of one culture are more empathetic than the other, as culture doesn't inherently make one more or less empathetic (Jami et al., 2024). Finally, it has been shown that a person's visual imagery ability can affect an individual's ability to empathize with others.

Imagination is a concept that almost everyone is familiar with; it is the ability to bring fantasies to life in one's mind. The scientific term for this is visual mental imagery and can be defined as "representations and the accompanying experience of sensory information without a direct external stimulus" (Pearson et al., 2015). This visualization process has been found to work as "vision in reverse", taking the usual flow of information from the retina and to the visual processing regions of the brain but reversing it (Milton et al., 2021), causing a person to "see" the thing they are imagining. During this process a number of regions in the brain are utilized including the frontoparietal regions, areas involved in memory, and the fusiform and primary visual cortices (Milton et al., 2021). Much of the regions used in this process overlap with the ones used in the process of perception. But research has shown that imagery and perception are two distinct processes and even though both imagery and perception use similar areas of the brain each area is used differently in each process (Lee et al., 2012). Like with many things involving the brain, there is a spectrum of how people experience visual mental imagery. On either end of this spectrum are two extremes: hyperphantasia and aphantasia. A fixed operational definition of aphantasia has been highly debated in the community; therefore, without a fixed definition results may not be generalizable. In this study aphantasia will be defined as an absence of visual mental imagery. And, on the opposite end, hyperphantasia will be defined as extremely vivid visual imagery. People on both sides of this spectrum continue to thrive in society as these differences in visual mental imagery are but unique differences in the human condition.

Previous research has found an association between imagery vividness and empathy. In study one of Monzel et al. (2023), the Vividness of Visual Imagery Questionnaire (VVIQ) and the Interpersonal Reactivity Index (IRI) were used to affirm his hypothesis that visual imagery vividness and empathy had a positive correlation. Monzel et al. based his hypothesis off of the previous work of Holmes and Matthew (2006, 2005, 2010), the Organizational Model of Empathy (Davis, 2018), and the Perception action model (Preston & De Waal, 2002). In study two of this paper, it was hypothesized that conventional empathy vignettes may be measuring visual imagery ability as empathy (Monzel et al., 2023). Using the VVIQ, PET (Pictorial Empathy

Test)(Lindeman, 2016), and verbalized PET he observed that empathy towards verbal descriptions of a person's experiences are influenced by visual imagery but not directly perceived experiences of others (Monzel et al., 2023). Milton et al. (2021) expanded on this point and examined visual imagery ability and its impact on emotion and autobiographical memory. It was observed that visual imagery ability may play into the emotions of a person's autobiographical memory (Milton et al., 2021). This observation, combined with those in Monzel et al.'s study, suggest that visual imagery ability may have influence over emotions including empathy. Furthermore, when looking at PTSD flashbacks and their effect on imagery (Wright et al., 2024), we see that people with aphantasia and PTSD experience less intrusive thoughts and flashbacks than others with PTSD (Wright et al., 2024). Building on these studies, we will be conducting research that explores the association between empathy and visual imagery. Current research focuses primarily on adults. We want to increase the body of knowledge on adolescents by conducting this study. The VVIQ and IRI have been used in previous studies on adolescents (Issac and Marks, 1994)(Davis, 1983). Using the VVIQ and IRI we will be exploring the relationship between empathy and visual imagery in adolescents. Using previous research from Monzel et al. (2023) we hypothesize that visual imagery ability will have a positive correlation in one or more aspects of empathy.

Methods

This study was conducted at Shattuck Saint Mary's (SSM) high school in Faribault, MN. It was approved by SSM's Research Ethics Review Board. Each participant reviewed and signed a consent form prior to participation in the study. The first phase of the study sampled 110 participants in grades 10-12 at SSM; based on their scores, 27 participants at SSM were randomly selected to participate in phase two of the study. Students completed both surveys during a designated period during the school day.

Phase One

Phase one occurred on January 16 and 23. The study participants completed the Vividness of Visual Imager Questionnaire (VVIQ). The VVIQ is a 16-item self report questionnaire that measures visual imagery using a five-point Likert scale (5 = 'No image at all, you only 'know' that you are thinking of the object' to 1 = 'Perfectly clear and as vivid as normal vision'). The scoring we used was the VVIQ-2 scoring (1 = 'No image at all, you only 'know' that you are thinking of the object' to 5 = 'Perfectly clear and as vivid as normal vision') to make our data more comparable to others. This survey has been validated for use in adolescents (Marks, 1973).

The VVIQ was administered using Survey Monkey on the participant's personal device. All participants completed the VVIQ during a designated time during the school day. They were encouraged to complete the questionnaire in a quiet and distraction-free environment.

Phase Two

Phase two occurred on February 2nd. We took the study subjects with the lowest 5 VVIQ scores, the highest 11 VVIQ scores, and 11 of midrange VVIQ scores, and had them all take the IRI. The IRI, (Davis, 1980), is a 28 item self-report questionnaire that measures empathy using a 5 point Likert Scale that gives participants various described situations. It measures cognitive and affective empathy using 4 subscales with 7 items each; fantasy (FS), empathetic concern (EC), perspective taking (PT), and personal distress (PD). The fantasy scale (tendency to

imagine oneself in fictional situations such as books, films or daydreams) and perspective taking scale (tendency to change perspectives when interacting with other people) refer to cognitive empathy. The empathetic concern scale (tendency to feel warmth, compassion and concern for others who are experiencing something negative) and the personal distress scale (tendency to feel discomfort and anxiety about others' negative experiences) measure affective empathy. This survey has been validated for use on adolescents (Sesso et al., 2021). The IRI has a reverse rating scale on select questions to account for empathy differences between males and females (Davis, 1980). We also used a reverse scale for all questions to make results comparable to other studies.

Procedure

Participants completed the IRI questionnaire on their own personal device during a designated time during the school day. The questionnaire was completed in a quiet environment of our choosing.

Data Analysis

To analyze data from the VVIQ and the IRI the Pearson correlation coefficient test was used with a one tailed p-value. We compared each IRI subscale score to the VVIQ scores.

Results

Results of the Pearson Correlation Coefficient test are listed in Table 1. The VVIQ significantly predicted IRI scores for the fantasy subscale. There was a moderate statistically significant positive correlation between the IRI fantasy subscale and visual imagery scores ($r=0.336, p<.05$)(Figure 1). A slight negative correlation was found between VVIQ scores and the IRI subscales perspective taking ($r=-0.0108$), empathetic concern ($r=-0.288$), and personal distress ($r=-0.186$). There was not a statistically significant correlation observed with perspective taking ($p=0.479$) and empathetic concern ($p=0.181$). Personal distress was almost statistically significant ($p=0.076$), this may be due to the small number of participants on the hypophantasic extreme of the VVIQ spectrum .

	r value	p value
FS	0.336	0.0465*
PT	-0.0108	0.479
PD	-0.186	0.0760
EC	-0.288	0.181

Table 1: Pearson correlation analysis between VVIQ scores and each IRI subscale between hyper, hypo, and typical scores for each IRI subscale

Notes: VVIQ = Vividness of Visual imagery

questionnaire, IRI = Interpersonal Reactivity Index,
*p<.05

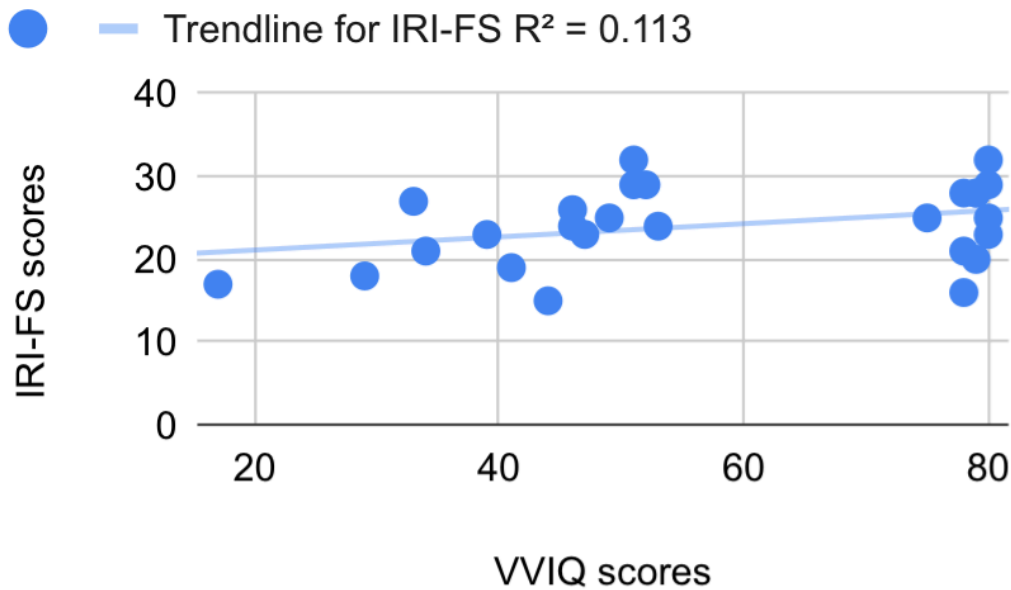


Figure 1: Scatterplot of Pearson Correlation Coefficient results between IRI-FS scores and VVIQ scores

Discussion

There was a moderate statistically significant correlation between IRI fantasy subscale and visual imagery. There was a slight negative correlation that was not statistically significant between empathetic concern, perspective taking, and personal distress IRI subscales and visual imagery.

Similar results were observed by Monzel et al. (2023), who administered the IRI and VVIQ on 2,232 participants that were between the ages of 18 to 82 years old. A hierarchical analysis was used to examine the relationship between gender and VVIQ scores on subscales of the IRI. After accounting for gender, the VVIQ scores significantly predicted the scores for the fantasy(0.45)($p<.001$), perspective taking (0.25)($p<.001$), and empathic concern (0.09)($p<.001$) IRI subscales. The personal distress subscale results were no longer significant after taking into account the VVIQ interaction with gender. The relationship between the VVIQ and the Fantasy scale of the IRI, while controlling for other variables, was strong and showed a positive correlation.

Based on the Organizational Model of Empathy (Davis, 2018), a mediation analysis was used to examine the effects of perspective taking on the relationship between VVIQ and the other 3 subscales. This model suggests that empathy is a sequence of events, starting with imagining the situation presented in the IRI (Mental Imagery). Next, the cognitive processes of perspective taking occur, followed by the emotional outcome. Empathetic concern and personal distress association with the VVIQ was fully mediated by the perspective taking subscale. The fantasy subscale was only partially mediated by the perspective taking subscale; therefore, they

suggest that fantasy may act as a mediator. They concluded that the fantasy subscale may, in part, be measuring visual imagery instead of empathy. This conclusion is supported by results from their second study where participants were assessed with the Pictorial Empathy Test (PET) and a verbalized version of the PET. The PET measures empathy using a variety of pictures and the verbalized version uses neutral descriptions of photos that are told to the participant. Empathy differences between aphantasics and controls were compared in the verbal and pictorial scenarios. After comparing these results to results in the first study, they found that controls showed higher empathy than the aphantasia group on the description-based version of the PET, but found no differences between the groups for the image based original PET. These results greatly support the conclusion that conventional empathy vignettes may be confounded by visual imagery ability.

Similarly, our results indicated that VVIQ scores moderately predicted the scores for the fantasy subscale ($p < 0.05$). This data supports Monzel et al.'s conclusion that visual imagery may be more closely tied to the fantasy/imaginative engagement aspect of empathy than other empathic processes. Observing the same relationship between VVIQ and FS scores in adolescents suggests that this relationship is fairly developmentally stable. In contrast, we found that there was no significant association between VVIQ and perspective taking, empathic response, and personal distress subscales in adolescents (ages 16-18). This result fits with the Organizational Model of Empathy in that lacking the ability of another's perspective, the emotional outcomes are less likely to occur.

While the present study examined the behavioral correlation between mental imagery and empathy, Kim et al. (2020) conducted a fMRI study to observe the differences in neural activation patterns in cognitive and emotional empathy between adults and adolescents. Using the IRI and Empathy Quotient (EQ) questionnaires, they found that overall adolescents (13-15 years old) show lower cognitive and emotional empathy. Compared to the adult group, adolescents had significantly lower IRI-total, IRI-PT and IRI-EC scores, however, there were no significant differences in IRI-FS or IRI-PD scores. Both groups underwent fMRI analysis of the brain during emotional empathy task condition – resting state condition (EE-R) and cognitive empathy task condition – resting state condition (CE-R). In both tasks participants were presented with different photographic stimuli; in the EE-R task they were asked, “How much are you feeling for this person?”, and in the CE-R task they were asked, “What is this person feeling?”.

The regions of interest (ROI) for the EE-R and CE-R examined areas of the brain that are directly and indirectly involved in empathy (Kim et al., 2020). Adolescents showed more activation in the brain ROI than the adult group in the EE-R condition, even though it has been shown that adolescents have lower emotional empathy than adults, as they score lower on all empathy questionnaires (Khanjani et al., 2015). This hyperactivation of emotional empathy regions in adolescents may be compensating for their lower emotional empathy ability. In addition, the adolescent group showed a negative correlation between the activation of the superior parietal lobule (one ROI for EE-R) and IRI-FS scores. This suggests that when adolescents show hyperactivation of emotional empathy brain regions when consuming fictional media, their cognitive empathy ability towards characters may be impaired (Kim et al., 2020). This conclusion is supported by the fact that adolescents scored lower on IRI-PT compared to adults. In the CE-R condition there were no differences in ROI activation between adults and adolescents, yet they still found adolescents scored lower on IRI-PT and IRI-EC than adults.

This could be partially due to the fact that cognitive empathy develops later (Gaspar and Esteves, 2022)(Hawk et al., 2013).

If we can conclude that the IRI-FS subscale may essentially be measuring visual imagery ability, we can infer that the negative correlation between IRI-FS and EE-R observed in Kim et al. is instead between visual imagery and emotional empathy. So as visual imagery increases, activation in emotional empathy brain regions decreases. Incorporating this into the Organizational Model of Empathy (Davis, 2018), it's possible that in adolescents visual imagery/IRI-FS is the catalyst for other cognitive processes like PT. But since adolescents are not fully mentally developed they lack the skills to process cognitive empathy preventing them from moving on to the cognitive processes step of the model. To compensate for their lack of cognitive empathy and emotional empathy ability the adolescent brain hyperactivates emotional empathy regions (because they developed much earlier than cognitive regions), but this does not allow them to bypass the other steps of the model. This hyperactivation of the emotional empathy regions without having emotional empathy ability causes adolescents to experience more intense emotions than adults without being able to process the emotions (Bailen et al., 2018)(Davis, 1983). It has been shown that the IRI-PT and IRI-FS increases as age progresses (Gaspar and Esteves, 2022) (Hawk et al., 2013) supporting the conclusion that adults rely less on visual imagery to experience another's perspective. A positive correlation between IRI-PT and IRI-EC (Davis and Franzoi, 1991)(Hawk et al., 2013) also supports the role that PT plays as a gateway to other emotional outcomes.

Limitations

Possible limitations of the present study include the small number of participants in either extremes of the visual imagery spectrum; hypophantasics (5/110), hyperphantasics (38/110). The percentage of hypophantastic participants and hyperphantastic participants were more than anticipated (Wright, 2024). This potentially may be because our subject pool was made up of competitive adolescent athletes, participants may have been biased to pick the socially desirable option on the IRI assessment, or the better score on the VVIQ. We also did not distinguish between males and females on the IRI, potentially skewing overall results because of the known empathy differences between adolescent males and females. The IRI also has subject variability in their interpretation of the questions in the assessment, which may affect adolescents more than adults. An alternative option instead of the IRI is the multifaceted empathy test - juveniles (MET-J), which mitigates social desirability bias. This test is specifically designed for adolescents and may have given us more reliable results.

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