Intrinsic motivation and perceived competence among junior doctors in managing ophthalmic disease

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Abstract

Introduction: Perceived competence among junior medical officers (JMOs) in managing ophthalmic disease remains low, and attempts to address this in ophthalmology education often neglect student motivation. This study aims to investigate whether JMOs' perceived competence in managing ophthalmic patients could be predicted by their levels of motivation while studying ophthalmology as medical students.

Methods: Seventy-one JMOs completed a 7-point Likert scale 34-item questionnaire. Intrinsic motivation as a medical student was measured using the Intrinsic Motivation Inventory (IMI), which included autonomy, competence, relatedness, interest and pressure subscales. Perceived competence in managing ophthalmic disease was measured using the Perceived Competence Scale (PCS). Linear regression analysis was used to determine if intrinsic motivation during medical school predicted perceived competence as JMOs.

Results: Mean IMI scores and PCS scores were low, at 59 (out of 133) and 14 (out of 28), respectively. PCS scores were positively correlated with IMI scores ($r = 0.61$, $p < 0.001$), competence ($r = 0.59$, $p < 0.001$), relatedness ($r = 0.49$, $p < 0001$) and interest ($r = 0.61$, $p < 0.001$) and negatively correlated with pressure ($r = -0.31$, $p = 0.009$) and female gender ($r = -0.30$, $p = 0.011$). Linear regression analysis showed that IMI scores ($\beta = 0.79$, $p < 0.001$) significantly predicted PCS scores. Subscale analysis showed that there was significant predictive value in competence ($\beta = 0.32$, $p = 0.009$) and interest ($\beta = 0.39$, $p = 0.035$) for PCS scores.

Conclusion: This study shows that intrinsic motivation of medical students studying ophthalmology is significantly predictive of their perceived competence as JMOs managing ophthalmic disease. These results point to the importance of fostering medical student intrinsic motivation in an effort to improve perceived competence in JMOs.

Keywords: ophthalmology; medical education; motivation; self-determination theory; junior medical officers

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Introduction

Diagnosing and managing ophthalmic conditions is an essential skill for medical graduates. Of the patients that present to the primary care setting, 2–19% have underlying ophthalmic disease, and a greater percentage are likely to present to hospital emergency departments (Fan et al., 2007; Helena et al., 2014; Vernon, 1988). Despite this, the time and resources allocated to ophthalmology teaching in medical schools are decreasing worldwide (Quillen et al., 2005). In the US and Canada, ophthalmology teaching has been declining over the past few decades (Moxon et al., 2020; Shah et al., 2014), while in the UK, many schools do not meet the International Council of Ophthalmology (ICO) recommendations for ophthalmology teaching (Baylis et al., 2011; Hill et al., 2017). In Australia, there has been a similar decline, with only 12 out of 19 Australian medical schools having an ophthalmology clinical rotation, and there is large interschool variation in curricula (Fan et al., 2007; Scott et al., 2022). These trends have been exacerbated by the impact of the COVID-19 pandemic (Duong et al., 2020; Succar et al., 2022).

In response, there have been recent reforms in the approach to undergraduate ophthalmic education, with less of a focus on teaching hours and more on novel teaching strategies, including peer-assisted learning activities (Sahoo et al., 2015), team-based learning activities (Huang et al., 2016) and self-directed and problem-based learning (Atta & Alghamdi, 2018; Sahoo, 2016; Wu & Greenberg, 2016). The use of technological initiatives have also proved effective, including virtual reality simulations (Wu & Greenberg, 2016), virtual clinics with case-based learning (Succar & Grigg, 2010, 2019; Succar et al., 2013) and eLearning modules (Petrarca et al., 2018).

Nevertheless, medical student perceptions of undergraduate ophthalmology teaching reveal a lack of confidence in ophthalmic skills and knowledge and a desire for more teaching to be provided (Li et al., 2016; Zhang et al., 2018). This sentiment is also echoed in medical graduates, who have been found to report low levels of confidence in managing ophthalmic disease (Zhang et al., 2018).

These findings highlight a need for continued improvement in ophthalmology education in medical school. This may be achieved through fostering students' intrinsic motivation, as emerging literature has suggested that this can improve learning independent of curriculum structure and teaching styles (Kusurkar, ten Cate, et al., 2011; Williams et al., 1994). Motivation is defined as the energy or intention to move oneself or others to act, and it constitutes the affective aspect of learning (Deci & Ryan, 2000; Ryan & Deci, 2000a, 2000b). This, along with cognitive (what to learn) and metacognitive (how to learn) aspects are all essential components of the educational process (Bransford et al., 2000; Vermunt, 1996). An effective model for studying motivation in medical students is self-determination theory (Deci & Ryan, 2000; Deci & Ryan, 2008; Ryan & Deci, 2000b). This theory describes a spectrum of motivation, ranging from amotivation, to extrinsic motivation and then intrinsic motivation (Deci & Ryan, 2000; Deci & Ryan,

2008; Ryan & Deci, 2000b). Amotivation is a total lack of motivation, while extrinsic motivation is acting as a response to external stimuli (Ryan & Deci, 2000b). Intrinsic motivation results from a person's internal desire to act out of their own volition, which is the most desirable quality of motivation (Ryan & Deci, 2000b).

The most optimal form of motivation in an educational setting, intrinsic motivation, is fostered by fulfilling three basic psychological needs—autonomy (one's ability to make their own choices), competence (one's belief in their capability) and relatedness (one's feeling of belonging to and being in a group) (Deci & Ryan, 1985; Ryan & Deci, 2000a, 2000b; ten Cate et al., 2011). It may also be influenced by non-modifiable factors, such as age, gender, ethnicity, socioeconomic status and educational background (Kusurkar, ten Cate, et al., 2011).

With the explicit consideration of these basic psychological needs, educators have been effectively improving educational outcomes by enhancing student motivation and wellbeing (Kusurkar et al., 2012; Kusurkar, Croiset, & ten Cate, 2011; Kusurkar, ten Cate, et al., 2011; ten Cate et al., 2011). By satisfying their autonomy, competence and relatedness needs, medical students showed greater intrinsic motivation and were found to engage in deeper learning and understanding, reflection and professional development (Kusurkar, ten Cate, et al., 2011). They are also more productive (Dolmans et al., 1998) and achieved higher academic grades in preclinical and clinical years (Moulaert et al., 2004; Sobral, 2004).

The study of intrinsic motivation in the context of ophthalmology education in medical school is limited. However, the need to develop intrinsic motivation in medical students studying ophthalmology is growing, given the reduced duration of ophthalmology rotations resulting in low levels of confidence and competence in students and junior medical officers (JMOs). Importantly, JMOs are often the first line in managing ophthalmic disease in the hospital setting and play an integral role in recognising ophthalmic emergencies, preventing the progression and deterioration of common ophthalmic conditions and facilitating timely referrals to speciality ophthalmology services. Hence, it is imperative to understand if the benefits of fostering intrinsic motivation in medical school persist when students graduate as JMOs. Therefore, this study seeks to answer if medical students' level of intrinsic motivation while studying ophthalmology predicts their perceived competence in managing ophthalmic patients as JMOs.

Methods

Study design and sample

A cross-sectional cohort study was performed across three tertiary hospital networks in Western Australia in January 2023. Participants were JMOs currently employed in Western Australia. A JMO is defined as an intern or resident medical officer who is not working in the role of a service registrar, accredited registrar or consultant.

Recruitment was through voluntary participation. Administrative offices of the South, North and East Metropolitan Health Services in Western Australia were contacted by the first author (DDCSD) via phone or email for permission to distribute online questionnaires to their JMOs. The online questionnaire was constructed using Qualtrics, LLC. DDCSD emailed a link to the questionnaire to JMOs across all three health services (n = 302). Responses of all participants did not contain any identifiable information to ensure anonymity (Johnson & Christensen, 2019), and informed consent was requested at the beginning of the survey.

Ethics approval was obtained from the UWA Human Research and Ethics Committee (2021/ET000800).

Tool descriptor

Data collection was carried out by a questionnaire of 34 questions in three domains: participant demographics, intrinsic motivation and perceived competence as a JMO. All questions were in a 7-point Likert scale format, with 1 = *not at all true* and 7 = *very true*. The questionnaire was reviewed by all authors and one independent academic (who is a lead lecturer in the School of Health Professions Education, UWA, with expertise in survey construction). This was done to ensure that the scale was appropriately testing the intended constructs, and ambiguous questions were reworded according to established survey standards (Kelley et al., 2003; Tran et al., 2020). Demographic data were included in the analysis, as it has been established that students' context and learning environment can influence their intrinsic motivation (Kusurkar, ten Cate, et al., 2011). Demographic data were analysed exploratively to identify factors that may predict PCS scores.

The intrinsic motivation domain of the questionnaire was adapted from the Intrinsic Motivation Inventory (IMI) and was used to measure intrinsic motivation towards ophthalmology in JMOs when they were in medical schools, retrospectively. This scale was developed by Ryan (1982) and has since been reported to have a high validity (McAuley et al., 1989). The IMI has also been widely and successfully adapted in different studies of motivation and self-determination theory (Deci et al., 1994; McAuley et al., 1989; Plant & Ryan, 1985; Ryan & Deci, 1987; Ryan et al., 1990; Ryan et al., 1983).

The IMI scale consists of subscales for interest, relatedness, autonomy, competence, pressure, usefulness and effort. Psychometric analysis of the IMI scale confirms that the exclusion of certain subscales does not affect the factor loading of other subscales (McAuley et al., 1989). To ensure that the survey was concise to address the aim, only the interest (IS), autonomy (AS), competence (CS), relatedness (RS) and pressure (PS) subscales were used in this study. Autonomy, competence and relatedness subscales were most appropriate, as they directly assess domains of motivation as outlined in self-determination theory. Pressure and interest have also been shown to be strong modulators

of intrinsic motivation (Dutt, Razavi, & Carr, 2023). Items in each subscale were chosen to ensure that the questions were not redundant and that each subscale includes a minimum of four items so as to maintain validity (McAuley et al., 1989; Ryan, 1982). All subscales were weighted equally. The perceived competence of JMOs was assessed by the Perceived Competence Scale (PCS). The PCS is a simple 4-item scale with high face validity. It has been used in previous studies on motivation in health-related behaviour (Williams et al., 1998) and perceived learning (Williams & Deci, 1996) with high predictive validity.

For this study, Cronbach's alpha was high for the IMI scale ($\alpha = 0.78$) and each of the subscales: interest ($\alpha = 0.94$), autonomy ($\alpha = 0.73$), competence ($\alpha = 0.83$), relatedness ($\alpha = 0.77$) and pressure ($\alpha = 0.76$), which confirms strong internal validity and is agreeable to alpha values found in previous studies ($\alpha > 0.70$) (Deci et al., 1994; McAuley et al., 1989; Plant & Ryan, 1985; Ryan & Deci, 1987; Ryan et al., 1990; Ryan et al., 1983). Cronbach's alpha was high for the PCS scale ($\alpha = 0.97$), which also confirms strong internal validity, where previous studies reported $\alpha > 0.80$ (Williams & Deci, 1996; Williams et al., 1998).

Statistical analysis

The IMI score is calculated using the autonomy, relatedness, competence, interest and pressure subscale scores (IMI score = AS + CS + RS + IS - PS). Mean scores for each scale and subscale were calculated, along with the satisfaction percentage, defined as the mean score divided by the total score for each scale or subscale (satisfaction rate (%) = mean score / total score). Cronbach's alpha was calculated for PCS, IMI and IMI subscales. Missing or invalid responses were removed from the raw data. Descriptive statistics were used for demographic data.

Two-tailed Pearson's correlation coefficient analysis was conducted between all variables, including PCS scores, IMI scores, IMI subscale scores and demographic data. From this analysis, meaningful correlations that arose and addressed the aim were included in multiple linear regression. Multiple linear regression between PCS scores as the dependent variable and independent variables (total IMI score, gender and if their degrees were postgraduate or undergraduate) was first calculated. IMI subscale scores were weighted equally in the linear regression model to account for variations in total scores. Males were assigned a value of 1 and females were assigned a value of 2 for the purpose of statistical analysis. This was followed by linear regression between PCS scores and IMI subscale scores, gender and if their degrees were postgraduate or undergraduate.

The assumptions of linear regression were tested prior to analysis. A Durbin Watson statistic of 1.50–2.50 was set to indicate no first order autocorrelation. Linear relationships between the dependent variable and each independent variable were tested separately by visual inspection of partial regression plots. Homoscedasticity was tested by plotting the studentised residuals against the unstandardised predicted values to ensure variances remained similar along the line of best fit. Multicollinearity was assessed by the

tolerance statistic and variance inflation factor (VIF), where a VIF < 3 was considered acceptable. Normal distribution of residual errors was assessed using normal Q–Q plots of studentised residuals. All analyses were carried out utilising IBM SPSS Statistics (SPSS, Chicago, IL, Version 20.0). Statistical significance is defined as $p < 0.05$.

Results

Demographics

There were 90 respondents altogether, however 19 surveys were incomplete and excluded from analysis. Hence, there were 71 responses analysed, of whom 40 identified as female (56%) and 31 identifying as male (44%). All respondents were employed as JMOs in the South, North or East Metropolitan Health Services in Western Australian, with a mean of 1.79 years (SD = 1.02 years) since graduating from medical school. All were taught ophthalmology in medical school, with 55 (77%) graduating with a postgraduate medical degree and 16 (23%) with an undergraduate medical degree. The majority of respondents graduated from an Australian medical school (n = 59, 83%), with other JMOs being international medical graduates (n = 12, 17%).

Descriptive statistics

Mean scores for the IMI scale, PCS scale and IMI subscales were calculated for the study population and are displayed in Table 1. The satisfaction rate of each subscale is also shown in Table 1, which provides a measure of the extent to which participants felt that a trait measured by a scale or subscale was satisfied.

Males had significantly higher mean scores for the IMI scale ($p = 0.012$), PCS scale ($p = 0.013$), autonomy subscale ($p = 0.036$) and interest subscale ($p = 0.022$). Mean scores for each of the IMI subscales and PCS scales were not significantly different when comparing JMOs who studied medicine as a postgraduate versus an undergraduate ($p > 0.05$).

Table 1

Means and Standard Deviation of IMI Scale, PCS Scale and IMI Subscales Scores for all Participants (n = 71)

	n	Total Score	Mean Scores	SD	*P*-value	Satisfaction Rate (%)	SD
IMI*	71	133	58.77	4.29	0.012	44.19	15.32
Males	31		65.66	19.67		49.37	14.79
Females	40		53.43	19.28		40.17	14.49
Autonomy subscale*	71	28	14.13	3.72	0.036	50.45	13.27
Males	31		15.16	3.34		54.15	11.94
Females	40		13.33	3.79		47.59	13.54

	n	Total Score	Mean Scores	SD	*P*-value	Satisfaction Rate (%)	SD
Competence subscale	71	28	15.62	5.18	0.104	55.79	18.51
Males	31		16.77	5.21		59.91	18.61
Females	40		14.73	4.98		52.59	17.79
Relatedness subscale	71	28	17.14	4.00	0.178	61.22	14.29
Males	31		17.87	3.81		63.83	13.60
Females	40		16.58	4.06		59.20	14.48
Interest subscale*	71	49	29.45	9.92	0.022	60.10	20.25
Males	31		18.62	5.91		66.49	21.10
Females	40		15.44	5.06		55.15	18.07
Pressure subscale	71	-28	-14.23	4.53	0.074	50.81	16.19
Males	31		-13.13	4.38		46.89	15.65
Females	40		-15.08	4.46		53.84	15.94
PCS*	71	28	13.52	5.77	0.013	48.29	20.60
Males	31		15.48	6.01		55.30	21.45
Females	40		12.00	5.08		42.86	18.14

Note: SD = standard deviation; satisfaction rate (%) = mean score / total score.

* significant at $p < 0.05$, ** significant at $p < 0.01$

P-values were derived by t-test comparing scores between males and females.

Correlation coefficients

Gender, degree type and years since graduating were the only demographic data included in the correlation analysis along with IMI subscale scores and PCS scores. The correlation matrix is shown in Table 2. Most importantly, there was significant positive correlation between PCS scores and total IMI scores ($r = 0.61$, $p < 0.001$). There was also significant positive correlation between PCS scores and competence ($r = 0.59$, $p < 0.001$), relatedness ($r = 0.49$, $p < 0001$) and interest scores ($r = 0.61$, $p < 0.001$). Pressure was negatively correlated to all other IMI subscales, including autonomy ($r = -0.23$, $p = 0.049$), competence ($r = -0.51$, $p = 0.000$), relatedness ($r = -0.56$, $p = 0.000$) and interest scores ($r = -0.53$, $p = 0.000$). Degree type and years after graduating medical school showed significant correlation ($r = 0.44$, $p = 0.000$), however this relationship was not used in further multiple linear regression as it did not meaningfully address the aim of this study.

Table 2

Pearson Correlation and P-Values of Each Independent Variable and Overall PCS Scores

		Gender	Degree Type	PGY#	AS	CS	RS	IS	PS	IMI	PCS
Gender	Pearson correlation	1									
	Sig. (2-tailed)										
Degree type	Pearson correlation	0.203	1								
	Sig. (2-tailed)	0.090									
PGY#	Pearson correlation	-0.057	0.443**	1							
	Sig. (2-tailed)	0.635	0.000								
AS	Pearson correlation	-0.245*	0.018	0.147	1						
	Sig. (2-tailed)	0.039	0.882	0.222							
CS	Pearson correlation	-0.196	-0.019	-0.078	0.026	1					
	Sig. (2-tailed)	0.101	0.875	0.520	0.830						
RS	Pearson Correlation	-0.161	0.116	0.237*	0.178	0.575**	1				
	Sig. (2-tailed)	0.181	0.336	0.047	0.138	0.000					
IS	Pearson correlation	-0.278*	-0.025	0.068	0.105	0.683**	0.684**	1			
	Sig. (2-tailed)	0.019	0.839	0.573	0.383	0.000	0.000				
PS	Pearson correlation	0.213	-0.064	-0.094	-0.234*	-0.510**	-0.563**	-0.528**	1		
	Sig. (2-tailed)	0.075	0.596	0.437	0.049	0.000	0.000	0.000			
IMI	Pearson correlation	-0.298*	0.034	0.111	0.362**	0.802**	0.820**	0.858**	-0.774**	1	
	Sig. (2-tailed)	0.012	0.779	0.358	0.002	0.000	0.000	0.000	0.000		
PCS	Pearson correlation	-0.300*	-0.171	0.026	0.174	0.588**	0.487**	0.608**	-0.307**	0.611**	1
	Sig. (2-tailed)	0.011	0.153	0.828	0.146	0.000	0.000	0.000	0.009	0.000	

Note: gender: male = 1, female = 2; degree type: postgraduate = 1, undergraduate = 2; PGY# = number of years from graduating medical school, AS = autonomy subscale scores, CS = competence subscale scores, RS = relatedness subscale scores, IS = interest subscale scores, PS = pressure subscale scores, IMI = total score for the IMI scale, PCS = Perceived Competence Scale score
* Correlation is significant at $p < 0.05$ (two tailed). ** Correlation is significant at $p < 0.01$ (two tailed).

Multiple linear regression

Linear regression was first performed between PCS scores and IMI scores to determine if the total motivation to study ophthalmology in medical school predicted perceived

competence to manage ophthalmic disease as JMOs. Number of years from graduating medical school was excluded from analysis because it correlated very weakly with PCS ($r = 0.026$, $p > 0.05$).

The assumptions of multiple linear regression analysis were tested prior to analysis. The Durbin Watson statistic was calculated as 1.90, which indicates no first order autocorrelation. Visual inspection of partial regression plots showed adequate linear relationships between individual independent variables and PCS scores. A plot of the studentised residuals against the unstandardised predicted values indicated presence of homoscedasticity. Variance inflation factor (VIF) was 1.05–1.16, and tolerance was high for all variables, indicating low multicollinearity. The Q–Q plots of studentised residuals confirmed normal distribution of residual errors. The results of the multiple linear regression analysis of IMI scores, gender and degree type for predicting PCS scores is shown in Table 3.

Table 3

Multivariate Linear Regression of IMI Scores, Gender and Degree Type for Predicting PCS Scores

	Unstandardised Coefficients		95.0% Confidence Interval for B		Standardised Coefficients B	*P*-value	Collinearity Statistics	
	B	SE B	Lower bound	Upper bound			Tolerance	VIF
(Constant)	29.46**	10.66	8.18	50.73		0.007		
IMI	0.790**	0.13	0.53	1.06	0.59	< 0.001	0.90	1.11
Gender	-3.68	4.16	-11.99	4.63	-0.09	0.380	0.87	1.16
Degree type	-8.56	4.72	-17.98	0.87	-0.17	0.074	0.95	1.05

Note: * significant at $p < 0.05$, ** significant at $p < 0.01$

Given these findings, the predictive value of undergraduate motivation levels on JMO perceived competence was further investigated by linear regression analysis between PCS scores and IMI subscales scores. All subscales were included in the analysis because Pearson's correlation coefficient was greater than 0.100 ($p < 0.01$). Gender and degree type were included in the analysis because correlation exceeded 0.100.

The Durbin Watson statistic was calculated as 1.881, which indicates no first order autocorrelation. There were adequate linear relationships between individual independent variables and PCS scores, and data was homoscedastic. The VIF was 1.085–2.602, and tolerance was acceptable for all variables. The Q–Q plots confirmed normal distribution of residual errors. The linear regression analysis of IMI subscale scores, gender and degree type for predicting PCS scores is shown in Table 4.

Table 4

Multivariate Linear Regression of IMI Subscale Scores, Gender and Degree Type for Predicting PCS Scores

	Unstandardised Coefficients		95.0% Confidence Interval for B		Standardised Coefficients B	*P*-value	Collinearity Statistics	
	B	SE B	Lower bound	Upper bound			Tolerance	VIF
(Constant)	-9.17	20.13	-49.40	31.06		0.650		
Autonomy	0.19	0.15	-0.11	0.49	0.12	0.206	0.88	1.14
Competence	0.39**	0.14	0.10	0.67	0.35	0.009	0.48	2.07
Relatedness	0.20	0.19	-0.19	0.59	0.14	0.303	0.45	2.23
Interest	0.32*	0.15	0.02	0.61	0.31	0.035	0.38	2.60
Pressure	0.19	0.15	-0.10	0.49	0.15	0.196	0.59	1.68
Gender	-3.94	4.10	-12.14	4.26	-0.10	0.340	0.83	1.21
Degree type	-7.23	4.62	-16.46	2.01	-0.15	0.123	0.92	1.09

Note: * significant at $p < 0.05$, ** significant at $p < 0.01$

Discussion

In this study, intrinsic motivation of medical students studying ophthalmology was a strong predictor of perceived competence in managing ophthalmic conditions as junior doctors, where an increase in IMI scores by 1 unit predicted an increase of PCS scores by 0.79 units. Demographic variables such as year of graduation, gender and degree type were not significant predictors of perceived competence. These findings are the first to provide empirical evidence to support fostering motivation in medical school to enhance perceived competence in junior doctors in managing ophthalmic disease.

Demographic data

Correlation between demographic data, including gender, and perceived competence was a secondary finding of this study, which emerged from explorative post-hoc analysis. Mean scores for PCS, IMI and IMI subscales were not significantly different for degree type or post-graduate year. PSC scores were not significantly predicted by degree type or post-graduate year. Males reported higher overall motivation, perceived competence, autonomy and interest compared to females (Table 1). However, gender was not a significant predictor of PCS scores in the linear regression analysis. Hence, while gender may impact on how motivation levels are perceived or reported, it may not serve as an accurate predictor of perceived competence in future years. This is in line with previous studies reporting inherent gender differences in self-reported motivation levels (Kusurkar et al., 2013; Meece & Painter, 2008). Evidence for gender differences in motivation for pursuing and studying medicine have been previously described (Kusurkar et al., 2012;

Kusurkar, ten Cate, et al., 2011). Males may overestimate perceived competence compared to females when academic grades were controlled for, which may be due to internalisation of different external pressures (Kusurkar et al., 2013; Meece & Painter, 2008).

Intrinsic motivation

Intrinsic motivations levels for JMOs during medical school ophthalmology rotations were low overall, with an average IMI satisfaction rate of 44%. The satisfaction rate of the individual basic psychological needs of autonomy, competence and relatedness were also low at 50%, 56% and 61%, respectively. There have been no studies that have commented on the extent of satisfaction of basic psychological needs in medical students studying ophthalmology. However, Dutt, Carr et al. (2023) provided an in-depth exploration of the variations of satisfaction of these basic psychological needs in the context of ophthalmology education in medical school that may result in amotivation (when these needs are not met), extrinsic motivation (when needs are partially met) or intrinsic motivation (when needs are fully satisfied). The present study suggests that students' basic psychological needs for motivation were not optimally addressed during undergraduate ophthalmology education, which may have limited the extent to which their intrinsic motivation was fostered.

The findings of this study are the first to demonstrate a correlation between motivation during medical school and perceived competence as junior doctors in managing ophthalmic disease. Previous research has reported that intrinsic motivation among medical students was significantly correlated with their perceived competence during an emergency medicine rotation during medical school (Pelaccia et al., 2009). Our study suggested that this correlation endures over time, from university to the workplace. Importantly, pressure was negatively correlated with overall motivation and all subscale scores in the preliminary correlation analysis. This is in line with findings from previous studies (Orsini et al., 2016; ten Cate et al., 2011). For example, medical students' self-reported perceptions of pressure arising from curriculum demands has been shown to significantly correlate with depression scores and amotivation (Park et al., 2012). Curricular and extracurricular pressure has also been shown to negatively impact on students' intrinsic motivation (Dutt, Carr, et al., 2023). It is important that this perceived pressure is minimised with strategies such as seeking formal and informal feedback on students' perceptions of curricular and extracurricular pressure, allocating the appropriate format and number of assessments, logically organising topics in the curriculum to complement each other, limiting lecture and tutorial content to that which is appropriate for medical students and promoting counselling and wellbeing services within the university (Dutt, Carr, et al., 2023).

Intrinsic motivation has been shown to be a predictor of improved learning outcomes in medical students (Dolmans et al., 1998; Kusurkar, ten Cate, et al., 2011; Moulaert et al., 2004; Sobral, 2004). The present study adds to the previous research by

demonstrating that intrinsic motivation predicts perceived competence among junior doctors in managing ophthalmic disease. This may be due to increased continuous learning behaviours and sustained knowledge gains that persist in students with high perceived competence as they transition to JMOs (Bandura et al., 1999; Pierce et al., 2001; Williams & Deci, 1996; Williams et al., 1998). Others suggest that increased JMO perceived competence may also be predictive of positive professional behaviour and job satisfaction (Spooner et al., 2001; Swarna, 2013).

Subscale analysis showed that student perceived competence and interest were significant determinants of JMO perceived competence. Interest is central to the definition of intrinsic motivation (Kusurkar, ten Cate, et al., 2011), and hence students' interest are likely to have an important contribution to their levels of intrinsic motivation (Kunanitthaworn et al., 2018). Students' interest in ophthalmology may also have been developed prior to their rotation. Hence, this interest may persist for longer compared to other subscale domains and play a larger role in impacting longer-term changes to perceived competence. Students' perceived competence may impact their perceived competence as JMOs by two mechanisms. Firstly, it may foster students' intrinsic motivation to engage in continuous learning in ophthalmology. Secondly, students may perceive themselves to be competent due to their objective performance, which is likely to be maintained as they transition to working as a JMO.

Perceived competence

Participants in this study reported a low overall perceived competence rate of 48%, which aligns with the existing evidence on this topic. The majority of JMOs in emergency departments in the UK reported low levels of perceived competence in managing ophthalmic diseases (Tan et al., 1997). These findings were replicated in a study conducted 10 years ago (Sim et al., 2008). Additionally, medical interns in India reported a significantly lower perceived competence in ophthalmology compared to interns in internal medicine and surgery (Bandhu et al., 2020). There have been no studies exploring the perceived competence of JMOs in managing ophthalmic disease in Australia. However, JMOs in Australia have reported low levels of confidence in ophthalmology-specific skills and knowledge and have felt that ophthalmology teaching was not prioritised in medical school (Zhang et al., 2018). Confidence refers to one's certainty that a particular choice or action is correct based on their prior knowledge or skill (Pouget et al., 2016) and is separate but closely related to the concept of perceived competence in educational psychology.

Perceived competence is effective in predicting sustained engagement and professional development, maintained behaviour change and internalisation of ambient values (Bandura et al., 1999; Pierce et al., 2001; Williams & Deci, 1996; Williams et al., 1998). Improving perceived competence may also improve wellbeing and decrease burnout and, hence, is an important outcome to measure (Neufeld & Malin, 2020). This emphasises

the importance of fostering perceived competence in JMOs, especially since perceived competence in JMOs in ophthalmic disease management is concerningly low. Improving this perceived competence may allow for improved wellbeing and proficiency in JMOs managing ophthalmic disease in primary care settings, which would greatly improve patient care. However, it may be a poor measure of objective performance (Barnsley et al., 2004; Jones et al., 2001).

Applications in ophthalmology education

This study suggests that an essential component of improving the perceived competence of JMOs in managing ophthalmic diseases is to foster intrinsic motivation among medical students. As such, educators should explicitly consider motivation when designing teaching programs and engaging with students in clinics and university teaching sessions (Dutt, Carr, et al., 2023). Firstly, educators must be informed on the affective processes of learning and the principles of self-determination theory. This includes understanding the importance of fulfilling students' basic psychological needs of autonomy, competence and relatedness and how this impacts on their intrinsic motivation, academic performance and sense of wellbeing (Kusurkar, Croiset, et al., 2011; Kusurkar, ten Cate, et al., 2011; ten Cate et al., 2011).

With this knowledge, strategies can be actioned to foster student intrinsic motivation. The negative correlation between pressure and all other subscales of intrinsic motivation suggests limiting perceptions of pressure that may result from time constraints or assessment style may result in improvements in intrinsic motivation (Dutt, Razavi, et al., 2023; Kusurkar, Croiset, et al., 2011; Kusurkar, ten Cate, et al., 2011; Orsini et al., 2016; ten Cate et al., 2011). Students' perceived competence may be fostered by improving the organisational structure of the medical school ophthalmology curricula (Dutt, Razavi, et al., 2023). Constructive feedback is also an effective strategy that can be employed to enhance perceived competence in medical students studying ophthalmology (Dutt, Razavi, et al., 2023).

Aspects of ophthalmology rotations that impact on student enjoyment and intrinsic motivation have been explored in previous studies, with the five most important factors being growth mindset, guidance, assessment and extracurricular and curricular pressure (Dutt, Razavi, et al., 2023). Additionally, educators may attempt to nurture intrinsic motivation by developing a nurturing learning environment and employing autonomy supportive teaching styles (Kusurkar, ten Cate, et al., 2011; Orsini et al., 2016). Educators may also choose ophthalmology curriculum designs that have been shown to improve student motivation, such as problem-based curricula, vertically integrated curricula and experience-based learning models (Dornan et al., 2007; Dornan et al., 2006; Norman & Schmidt, 1992).

Educators may also gauge the impact of curriculum development and teaching practices on student motivation and perceived competence through longitudinal review with

IMI and PCS scales. This allows for objective measures of intrinsic motivation to guide educational reform.

Applications in medical education

Importantly, these findings may be extrapolated to other areas of medical education. Medical schools tend to allocate a disproportionate amount of the curriculum to larger disciplines, such as general medicine and general surgery (Quillen et al., 2005). As a result, educators and coordinators of smaller disciplines, such as otolaryngology, obstetrics and gynaecology and anaesthetics, experience similar challenges to those faced by ophthalmology education (Carmody et al., 2009; Cheung et al., 1999; Yau et al., 2021). Therefore, many of the recommendations offered in this study can be considered in these disciplines. All discipline leads should still be encouraged to explicitly consider the role of curriculum design and teaching practices on student motivation. Additionally, all faculty members should also aim to become familiar with the literature on motivation in medical education.

Limitations

JMOs from the South, East and North Metropolitan Health Services in Western Australia were invited to participate to encourage a large and diverse sample. Despite this, the study had a relatively small sample size and, hence, may not be a complete and generalisable representation of the population. However, the sample was heterogenous, including JMOs from different universities, different graduating years and different hospital networks, improving the generalisability of findings. Peer relationship may have influenced some JMOs to enrol in the study, as the lead researcher was a JMO at the time of conducting the study and may have worked with some participants previously.

Data on duration of rotations or the stage of the degree they occurred in were not collected, which may reduce uniformity in the ophthalmology education that participants experienced. Recall bias may have been present due to the self-reported nature of the study. However, the impact of recall bias was minimised as the majority of JMOs were recent graduates. Additionally, the IMI subscale is used retrospectively in the present study, however the temporal stability of the IMI has been established in previous studies (Tsigilis & Theodosiou, 2003). This study also focuses on the internal factors of motivation and perceived motivation. Whilst external factors also undoubtedly mediate this relationship, the impact of this was not explored in this study and is a potential topic for future research.

This study also does not provide a measure of objective performance of JMOs in managing ophthalmic disease. Objective performance is difficult to assess in the clinical environment, as robust measures of outcome that are directly attributable to the effects of training have not been defined (Epstein, 2007). The impact of motivation during medical school on the objective clinical performance of JMOs is an area that warrants further research. Future research may choose to investigate factors that impact motivation

in ophthalmology education to provide educators with actionable recommendations for curriculum development.

Conclusion

Ophthalmology education in medical schools has undergone many developments in recent years. However, the perceived competence of JMOs in managing ophthalmic diseases remains low and is a cause for concern. Whilst attempts to address this include improvements to teaching practices, these often neglect student motivation, which is central to the affective component of learning. The findings of this study highlight the importance of directly addressing and fostering medical student motivation to improve perceived competence in JMOs.

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Appendix

Questionnaire Administered to JMOs

Demographics

1. Are you a current doctor employed in the WA health service?
2. What university did you attend?
3. What year did you graduate from medical school?
4. Was your medical degree a postgraduate degree? If so, what was your undergraduate degree?
5. Did you attend an ophthalmology placement/rotation in medical school?
6. What gender do you identify as?

For each of the following statements, please indicate how true it is for you, using the following scale:

1 (Not true at all), 2, 3, 4 (somewhat true), 5, 6, 7 (very true)

7. I felt close to my teachers (ophthalmologists and non-ophthalmologists) during my ophthalmology rotation.
8. I enjoyed my ophthalmology placement in medical school very much.
9. I did not feel nervous at all during my ophthalmology placement in medical school.
10. My ophthalmology placement in medical school was a placement that I could not do very well in.
11. My ophthalmology placement in medical school was fun to do.
12. I thought my ophthalmology placement in medical school was a boring activity.
13. I engaged in activities during my ophthalmology placement in medical school because I had to.
14. After my ophthalmology placement in medical school, I felt pretty competent.
15. I felt really distant to my teachers (ophthalmologists and non-ophthalmologists) during my ophthalmology rotation.
16. My ophthalmology placement in medical school did not hold my attention at all.
17. I felt pressured while doing my ophthalmology placement in medical school.
18. I was pretty skilled at my ophthalmology placement in medical school.
19. I did not really have an opportunity to choose what to do during my ophthalmology placement in medical school.
20. I would describe my ophthalmology placement in medical school as very interesting.
21. I was satisfied with my performance during my ophthalmology placement in medical school.

22. I felt like I had to participate in my ophthalmology placement in medical school.
23. I felt like I could really trust my teachers (ophthalmologists and non-ophthalmologists) during my ophthalmology rotation.
24. I was very relaxed during my ophthalmology placement in medical school.
25. I thought my ophthalmology placement in medical school was quite enjoyable.
26. While I was doing my ophthalmology placement in medical school, I was thinking about how much I enjoyed it.
27. I believe I had some choice during/within my ophthalmology placement in medical school.
28. I would really prefer not to interact with my ophthalmology teachers (ophthalmologists and non-ophthalmologists).
30. I was anxious while working on my ophthalmology placement in medical school.
31. I feel confident in my ability to manage patients with ophthalmic disease/presentations at a JMO level.
32. I have been capable of managing patients with ophthalmic disease/presentations at a JMO level.
33. I am able to carry out routine management for patients with ophthalmic disease/presentations at a JMO level.
34. I feel able to meet the challenge of managing new patients with ophthalmic disease/presentations at a JMO level.