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## Family experiences, the motivation for science learning and science achievement of different learner groups

 **Salomé Schulze**

Department of Psychology of Education, Faculty of Education, University of South Africa, Pretoria, South Africa  
schulsa@unisa.ac.za

 **Eleanor Lemmer**

Department of Educational Foundations, Faculty of Education, University of South Africa, Pretoria, South Africa

Science education is particularly important for both developed and developing countries to promote technological development, global economic competition and economic growth. This study explored the relationship between family experiences, the motivation for science learning, and the science achievement of a group of Grade Nine learners in South Africa. A purposeful sample of 380 learners from three racial groups in public and independent schools completed the Student Motivation for Science Learning questionnaire combined with items investigating family experiences. The findings indicate that family experiences correlated significantly with three motivational aspects of science learning (self-efficacy, active learning and achievement goals); boys perceived family experiences significantly more positively than girls; and parental educational level as well as school values seemed to be related to science learning. Recommendations were made as to how schools can support families in enhancing family experiences that promote learners' motivation for science learning and science achievement.

**Keywords:** family experiences; gender; motivation; racial group; school type; science achievement; science learning

### Introduction

Science education is particularly important for both developed and developing countries to promote technological development, global economic competition and economic growth (Perera, Bomhoff & Lee, 2014). In South Africa, poor science achievement has consistently been demonstrated by the dismal performance of secondary school learners in international assessments such as the Trends in International Mathematics and Science Study (TIMSS) (Reddy, 2005; Reddy, Prinsloo, Arends, Visser, Winnaar, Feza, Rogers, Janse van Rensburg, Juan, Mthethwa, Ngema & Maja, 2012; Spaul, 2013). Consequently, science education in South Africa is a national concern to industrial leaders and the educational community (Spaul, 2013).

Motivation to learn can be defined as "the degree to which students invest attention and effort in various pursuits, which may or may not be the ones desired by their teachers" and a distinction is made between achievement (also called mastery) and performance motivation goals (Brophy, 2010:3). With regard to science learning, learners motivated by achievement goals engage in science learning for the satisfaction that they attain by acquiring new knowledge and skills (Vedder-Weiss & Fortus, 2012). In contrast, learners who are motivated by performance goals compare themselves to others and compete to be better than their peers in science learning (Vedder-Weiss & Fortus, 2012; Velayutham, Aldridge & Fraser, 2011). Learners are also motivated to learn science if they have positive self-efficacies (e.g., they believe that they can be successful) (Maddux, 1995).

Different studies worldwide have investigated factors related to motivation for science learning. Researchers have identified a link between science achievement, the motivation to learn science and the following: gender and race (Breakwell, Vignoles & Robertson, 2003; Leaper, Farkas & Brown, 2012; Muller, Stage & Kinzie, 2001); significant others such as teachers and their pedagogies, and peers (Vedder-Weiss & Fortus, 2013); and family experiences that include parental involvement in science learning (Archer, DeWitt, Osborne, Dillon, Willis & Wong, 2012; Harackiewicz, Rozek, Hulleman & Hyde, 2012; Shumow, Lyutykh & Schmidt, 2011; Tenenbaum & Leaper, 2003), parental attitudes towards science learning (Perera et al., 2014), parental education and occupation (Ho, 2010) and the socio-economic status (SES) of the family (Gorard & See, 2009). In particular, family influences have been singled out as a key influence on the motivation for science learning and science achievement (National Science Teachers Association, 2009).

In South Africa, several factors have been identified as having an influence on science motivation and science achievement: inadequate school resources and weak household infrastructure (Maree, Aldous, Hattingh, Swanepoel & Van der Linde, 2006); poor teacher preparedness to teach science and weak science pedagogy (Seroto, 2012); limited English proficiency of learners (Howie, Scherman & Venter, 2008); poor quality of learning environments that demotivate students to learn science (Ramnarain, 2013) and negative learner attitudes to science with reference to a lack of enjoyment, insight into the value of science and poor self-efficacy for learning science (Juan, Reddy & Hannan, 2014). However, South African studies that have focused exclusively on the influence of family experiences on motivation for science learning and achievement are limited. An analysis of South African science performance in TIMSS 2011 gave some attention to family variables as an explanation for TIMSS results. A strong positive relationship was indicated between participants' science achievement and parental education. Only 19% of South African participants in TIMSS

2011 had at least one parent/caregiver who had completed a university degree or higher qualification (Reddy et al., 2012). Mashile (2001) demonstrated the difficulty of using SES, parent involvement and parental attitudes to determine science achievement in the South African context. Makgato and Mji (2006) undertook a qualitative study of science performance in township schools in Gauteng refers, attesting among others, to the negative influence of poor parent involvement on the science achievement of learners from disadvantaged families. They found that learners and teachers believed that parents' low educational levels and lack of scientific literacy precluded them from any meaningful involvement in their children's science learning that could be motivational. A very high correlation was found between family environment and attitudes towards science of Northern-Sotho speaking learners in a survey of a large sample of Grade 12 learners in the Northern Province of South Africa (Cherian, L & Cherian, VI, 1998). In particular, impoverished family environments of the respondents in this study affected attitudes towards science negatively. However, no South African studies could be found that investigated the extent to which different learner groups differed in their family experiences, and hence, their motivation for and achievements in science. A South African study found that the Grade Nine learners in the sample, in particular the black learners, were more motivated for science learning by achievement goals than by performance goals; and the independent school learners were significantly more motivated by self-efficacy and achievement goals (among others) than the public school learners (Schulze & Van Heerden, 2015). However, the study did not report on the link between family experiences on the motivation for and achievement in learning science. In the light of this, this article investigates the following main problem: *What is the relationship between family experiences, the motivation for science learning and science achievement of different learner groups?*

#### Theoretical Framework

To inform the investigation, attention has been paid to key theories concerning the relationship of family experiences and educational outcomes, such as science learning: Eccles' (2009) value-expectancy model of achievement-related choices; Marjoribanks' (1976, 1979, 2005) social learning theory of the family, and Hoover-Dempsey and Sandler's theory of parent efficacy (1997).

Marjoribanks' (1976) social learning theory of the family is based on the premise that children interact with, observe and imitate parents who function as role models of knowledge, skills, attitudes and conduct. Family influences moderate formal school learning and individual cognitive

differences (Marjoribanks, 1979). Thus, differences in children's performance in learning tasks and achievement orientation are shaped by the learning environment of the home. Marjoribanks (1976) defines the latter in terms of parents' expectations and the cognitive stimuli and reinforcement provided by the family. Further, Marjoribanks (2005) distinguishes two influential dimensions of family experiences on children's learning: distal family background (i.e., SES, parental education and ethnicity) and proximal family background (i.e., parental processes, provision of at home educational resources associated with school success, and support for the child's education and future plans). Although distal family background cannot be altered, proximal family background can be shaped with a view to promoting children's educational outcomes. Applied to science learning, parents can model an "achievement orientation" (Marjoribanks, 1976:35) towards science, provide educational resources and experiences in the home directed at stimulating science learning, motivate children to choose science as a school subject, encourage children to consider science in their future plans, and promote the choice of science oriented occupations.

An important component of the proximal social learning environment created by the influence of family experiences on children's science learning is the extent to which parents help children to perceive value in the scientific field (Harackiewicz et al., 2012). According to the expectancy-value model of achievement-related choices developed by Eccles and her colleagues (Eccles, Adler, Futterman, Goff, Kaczala, Meece & Midgley, 1983), students elect to embark upon a demanding learning assignment if they expect that they can succeed at the task on the basis of both self-beliefs and the positive values associated with the task. Task value depends on intrinsic value (personal enjoyment) and utility value (how useful or relevant the task). Utility value plays a powerful role in determining how persistently a learner will engage in a difficult task or course of study. According to Eccles (2009), parents' beliefs and attitudes shape their children's expectancy-value of achievement related choices. When applied to science learning, if parents believe children capable of achievement in science and believe that science is relevant to their child's future occupational success, they will encourage them to opt for science, provide educational resources to sustain such engagement, and highlight the advantages of science-orientated careers. In this process, the school also plays a role: the school should inform and persuade parents of the utility value of science and ways that parents can convey that value to their children (Harackiewicz et al., 2012). Further, schools should inform parents of their children's science abilities and progress and thus stimulate

parental expectancy that their children can indeed succeed in science. This is crucial in lower socio-economic or scientifically illiterate communities, where the utility value of science may be misunderstood.

Hoover-Dempsey and Sandler (1997) posit the parents' sense of efficacy, that is, the parents' belief in their own abilities to act in ways that will improve their children's educational outcomes, shapes the extent to which parents will create family experiences which promote academic achievement. Building on Bandura's (1997) concept of self-efficacy as a significant factor in decisions about goal determination as well as the effort and persistence applied to goal accomplishment, Hoover-Dempsey and Sandler's (1997) parent efficacy theory proposes that parents make decisions and formulate behavioural goals for their own involvement in a child's education, based on self-appraisal of their capabilities. Thus, parents high in efficacy tend to make positive decisions about active involvement in the child's education, and they are likely to persevere in seeking and attaining these goals in the face of obstacles such as lack of time and work pressures, which impede parent involvement in education. Relatively weak self-efficacy for parent involvement is often associated with lower parental expectations about outcomes or efforts to help the child succeed in school, lower aspirations for the child, and indifference to creating a positive learning environment at home. Parental efficacy is demonstrated, among others, in the kind of learning support parents offer their children and the intensity and scope of their engagement in a child's future goals. Parent efficacy is useful as an explanatory theory in instances where parents are called upon to support children in so-called 'difficult' subjects, such as science. Poor parent efficacy negatively affects the support given to children. Further, in disadvantaged social contexts, poorly educated parents may regard themselves as unable to support the child's formal education, particularly science learning, and thus neglect to create family experiences that will influence science learning positively.

In view of the above exposition on the possible link between family experiences, the motivation to learn science and academic achievement (e.g., Leaper et al., 2012; Makgato & Mji, 2006; National Science Teachers Association, 2009); the impact of gender (Breakwell et al., 2003) and race (Muller et al., 2001), as well as the effect of school type on the motivation to learn science (Schulze & Van Heerden, 2015), the following hypotheses were stated: (1) there is a significant correlation between family experiences and four factors of motivation for science learning (self-efficacy, active learning, performance goals and achievement goals); (2) there is a significant difference in the family experiences of learners of low, average

and high levels of science achievement; (3) there is a significant difference between the family experiences of males and females; (4) there is a significant difference between the family experiences of different racial groups (white, coloured and black); (5) there is a significant difference between the family experiences of learners from schools located in different socio-economic areas; and (6) there is a significant difference between the family experiences of learners from the two school categories, namely independent and public schools.

### Method

To test the abovementioned hypotheses, a purposeful sample of 380 Grade Nine learners from four secondary schools were selected for the study (McMillan & Schumacher, 2014). School A to C were independent Christian schools and school D was a public school. The schools were also located in different socio-economic areas. Participation at the schools was as follows: School A, 47 learners; School B, 82 learners; School C, 54 learners, and School D, 197 learners. In total, 133 were boys and 186 were girls; 284 learners were black; 20 learners were coloured and 38 learners were white.

All the required steps for ethical research were followed, which included ethical clearance from the Ethical Clearance Committee of the institution, as well as written consent and assent from parents and the learners, respectively. Two pen and paper questionnaires were identified in the literature and adapted for use in the study, namely the 'Student Motivation to Learn Science' (SMLS) questionnaire (Tuan, Chin & Shieh, 2005) and a questionnaire that focused on family experiences (Viljoen, 2012). In the first section of the questionnaire, respondents indicated gender, racial group and the latest cumulative grade achieved for science (less than 50%, 50 to 69%, and 70% and above). The second section of the questionnaire determined the learners' motivation, where 35 items clustered around four factors seen as relevant to family experiences: "I am sure that I can do well on science tests" is an example of an item which tested self-efficacy; "when learning new science concepts, I connect them to my previous experiences" measured active learning strategies; "I participate in science courses to perform better than other students" assessed performance goals; and "I feel most fulfilled when I am able to solve a difficult science problem" measured achievement goals. It is noted here that questionnaire items related to the teachers' pedagogy were omitted for the purposes of this investigation. Responses were indicated on a five-point, Likert-type scale that ranged from 'strongly disagree' to 'strongly agree'. Regarding reliability, the Cronbach's alphas on the subscales of the SMLS were .7 and above. The reliability was 0.79 overall for the second section (the motivation section) and for the third section

(family experiences) it was 0.87. As a result, the questionnaire items were viewed reliable (McMillan & Schumacher, 2014). The items were also judged as relevant by a colleague who is an expert in science education, but was not involved in the study. According to him, the questionnaire had face validity with regard to SMLS. The last section of the questionnaire (13 items) was adapted from Viljoen's (2012) questionnaire. Items in the original questionnaire deemed irrelevant for the purposes of this study were omitted, for example two items related to romantic relationships with the opposite sex. In line with the theoretical framework of this study, items were included that focused on proximal childhood experiences (emotional and practical support, care and well-being), and distal childhood experiences (SES, parental education). The items implemented a six-point semantic differential by means of adjective pairs. An example of an item that assessed proximal family experiences is "in my family the opportunity to learn new

things is seen as: unimportant versus important". An item that measured distal family experiences included "regarding money we are: in distress, rather than comfortable".

To test the hypotheses on the relationship between family experiences, motivation and achievement in science (stated in the previous section), the following statistical techniques were applied by means of the Statistical Package for the Social Sciences (SPSS) programme: a comparison of correlations, means and standard deviations, *t*-tests and Analyses of Variance (ANOVA). Effect size was also considered.

## Results

### Hypothesis 1

Spearman's correlation was calculated to determine if there were significant correlations between family experiences and certain motivation variables. The results are found in Table 1.

**Table 1** Correlations and significance of correlations between family experiences and motivation variables

Variable	Correlation with family experiences	Significance
		<i>p</i>
Self-efficacy	.3	< 0.01
Active learning	.3	< 0.01
Performance goals	.01	> 0.05
Achievement goals	.12	< 0.05

Note. *N* = 373; missing values = 7.

Two correlations were significant on the 1% level: the correlations between family experiences, and self-efficacy as well as active learning; the correlation between family experiences and achievement goals was significant on the 5% level. All correlations were positive. When sample size is considered, the educational impact of two correlations is seen as moderate (0.3 and above) (Cohen, 1988): these are the correlations between family

experiences (on the one hand) and self-efficacy and active learning (on the other hand).

### Hypothesis 2

ANOVAs determined whether the family experiences of learners in different achievement categories differed significantly. The results are in Table 2.

**Table 2** Means, standard deviations and significance of differences between the family experiences of high, average and low science achievers

Low (below 50%) ( <i>N</i> = 44)		Average (50 - 69%) ( <i>N</i> = 183)		High (70% and above) ( <i>N</i> = 75)		<i>F</i>	Sig. ( <i>p</i> )	<i>d</i>
<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>			
4.939	.738	5.137	.692	5.177	.774	1.394	<i>p</i> > 0.05	0.01

Note. *df* = 2; missing values = 78.

There were no statistically significant differences between the family experiences of learners in different achievement categories. Partial eta squared was 0.01 indicating a small effect size. The mean scores in Table 2 indicate that for this sample, the higher the learners achieved, the more positive were their family experiences and *vice versa*. However, it should be noted that a large number of 78 learners did not indicate their

achievements. This implies that many learners could not remember what their achievements were.

### Hypothesis 3

A *t*-test was calculated to determine if there was a significant difference between the family experiences of boys and girls. The results are found in Table 3.

**Table 3** Means, standard deviations and the significance of the difference between the family experiences of boys and girls

Male ( <i>N</i> = 133)		Female ( <i>N</i> = 183)		<i>t</i>	Sig. ( <i>p</i> )	<i>d</i>
<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>			
5.24824	.662	5.08137	.715	2.113	<i>p</i> < 0.05	0.23

Note. *df* = 1; missing values = 3.

Table 3 shows a statistically significant difference between the genders regarding their family experiences. Cohen's ratio for effect size (*d*) indicates a practical influence of 0.23, which is relatively large (Cohen, 1988). The mean values indicate that the boys in this sample perceived their family experiences significantly more positively than the girls in the sample.

#### Hypothesis 4

The results of testing for significant differences between the family experiences of three racial groups (black, coloured and white) are illustrated in Table 4.

According to Table 4, there were no statistically significant differences between the family experiences of the racial groups, and partial eta squared was only 0.003. Thus, the differences in means are trivial. However, it should be noted that there were 39 missing values, which could have influenced the results.

#### Hypothesis 5

This hypothesis tested for significant differences between the family backgrounds of learners from the four schools. The results are in Table 5.

**Table 4** Means, standard deviations and significance of differences between the family experiences of learners from different racial groups

White ( <i>N</i> = 38)		Black ( <i>N</i> = 283)		Coloured ( <i>N</i> = 20)		<i>F</i>	Sig. ( <i>p</i> )	<i>d</i>
<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>			
5.196	.595	5.141	.681	5.006	.914	.542	<i>p</i> > 0.05	0.003

Note. *df* = 2; missing values = 39.

**Table 5** Means, standard deviations and significance of differences between the family experiences of the learners at the different schools

School A ( <i>N</i> = 47)		School B ( <i>N</i> = 81)		School C ( <i>N</i> = 53)		School D ( <i>N</i> = 193)		<i>F</i>	Sig. ( <i>p</i> )	<i>d</i>
<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>			
5.17	.68	5.02	.70	5.31	.59	5.06	.87	2.032	> 0.05	0.02

Note. *df* = 3; missing values = 6.

**Table 6** Means, standard deviations and significance of differences between the family experiences of independent and public schools

Independent ( <i>N</i> = 181)		Public ( <i>N</i> = 194)		<i>F</i>	Sig. ( <i>p</i> )	<i>d</i>
<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>			
5.142	.67	5.0061	.87	1.004	<i>p</i> > 0.05	0.2

Note. *df* = 1; missing values = 5.

There was no statistically significant difference between the family experiences of learners of independent versus public schools, but Cohen's *d* shows an effect size of 0.2. Therefore, considering that the mean values of the learners at the independent (Christian) schools were higher than of

According to Table 5, there were no statistically significant differences between the family experiences of learners from the four schools. However, partial eta squared was 0.02, which reveals a small practical influence of school. In this regard, it should be noted that School C is likely to have had the most educated parent body and School B the least educated parent body. This information was not empirically obtained, but acquired through informal interviews with the science teachers of the schools. School C was also situated in an affluent suburb in contrast to the environment in which School B was located, where the SES of an environment seems to be related to the educational level of its inhabitants (Viljoen, 2012). The mean scores for positive versus less positive family experiences are in line with this: learners in School C had more positive family experiences than learners in School B, although the difference was not statistically significant.

#### Hypothesis 6

This hypothesis tested for significant differences between the family experiences of learners from independent and public schools. Table 6 illustrates the results.

the public school group, there was a relatively large practical impact of school type. The learners from the three independent schools perceived more positive family experiences than did the learners from the public school.

## Discussion

The results revealed that family experiences correlated significantly with three motivational aspects of science learning, namely self-efficacy (0.3), active learning (0.3), and achievement goals (0.12) (cf. hypothesis 1). It would appear that respondents' self-efficacy in science learning, as determined by questionnaire items that explored, among others, self-confidence in the ability to learn science, to understand science content and to persevere in challenging science learning activities, correlated with proximal family experiences (Marjoribanks, 2005), as reflected by items in the final part of the questionnaire. Therefore, parents who express an interest in the child's further education, entertain high expectations for the child's future, and encourage engagement in learning new things boost the child's feeling of being able to engage in 'difficult' subjects like science (Ho, 2010). Similarly, learners' employment of active learning strategies appears to be correlated to proximal family experiences. Parents who provide an enriching learning environment and promote novel learning experiences encourage the child's willingness to actively make connections with prior knowledge, explore new concepts, and seek explanations for new and challenging content during science learning (Urdu, Solek & Schoenfelder, 2007). These findings highlight the important responsibility shared by all parents in providing strong emotional and practical support for the child's science learning, irrespective of parental expertise in or prior experience of science as a discipline (Karaçöp, Akıllı & Aksu, 2016). Furthermore, the findings suggest that distal family experiences (Marjoribanks, 2005) as also reflected in the questionnaire, such as status of parental occupation, housing conditions and neighbourhood, correlate with a learner's achievement goals expressed in, among others, science grades as well as peers and teachers' respect for science ability. Living in an adequate home and being supported by parents who have valued occupations promotes higher achievement goals among learners. Clearly these kind of family experiences are related to SES status and are predominantly static (Marjoribanks, 1976, 2005). This finding has particular implications for science learning in South Africa, where poverty and unemployment are rife and many learners live in inadequate circumstances (Statistics South Africa, 2014).

Although several missing values occurred for science achievement, making interpretation difficult and indicating a need for further research, the results suggest that there was only a small practical impact of family experiences on science achievement ( $d = 0.01$ ). This makes sense in light of the fact that a family that is emotionally stable (as indicated by family love, harmony and general well-being), which provides adequate infrastructure

(as indicated by housing, physical care and location), together with educational capital (as indicated by availability of educational resources and parental expectations in future plans), can affect achievement positively in any subject. With regard to science, the respondents who reported the most positive family experiences ( $M = 5.177$ ), achieved the best in science (70% and above), while the respondents who reported the least favorable family experiences ( $M = 4.939$ ) achieved the lowest in science (less than 50%). Learners who achieve good results in a difficult subject, such as science, will both expect that they will achieve similarly in future, and will attach value to the subject (Eccles, 2009). It can be argued that positive family experiences may lead to sustained engagement in science by respondents who achieved high scores when science becomes an elective school subject in Grade 10.

Regarding gender, the results show that the boys in this sample perceived their family experiences significantly more positively than the girls in the sample ( $M = 5.24824$  and  $5.08137$ ;  $t = 2.113 = p < 0.05$ ). Given that family experiences affect motivation for science, and that girls worldwide are underrepresented in science learning (Ceci & Williams, 2011), this is an important finding. However, the reasons for the girls' perceptions fall outside the scope of this study, and require further investigation, possibly of a qualitative nature. Regarding racial group, the results indicate no statistically significant differences in the family experiences of the racial groups (black, coloured and white) represented in the sample ( $p > 0.05$ ). This is a positive finding in the light of the historical differences in family background and family capital associated with ethnicity in South Africa (Statistics South Africa, 2012).

The findings of the testing of Hypothesis 5 indicated no statistically significant dependency between school context and family experiences, although there was a small practical impact ( $d = 0.02$ ). As noted, School C may serve a learner body with the most educated group of parents in contrast to school B. Accordingly, the means show that the family experiences of the learners in School C is the most positive ( $M = 5.31$ ) and in School B the least positive ( $M = 5.02$ ) of the four schools. Parents in higher status occupations can be expected to show higher levels of efficacy in terms of their involvement in and expectations for their children's future plans (Hoover-Dempsey & Sandler, 1997) than parents in lower status occupations.

The testing of Hypothesis 6 indicated statistically insignificant differences, but Cohen's  $d$  (0.2) indicate some practical influences in terms of the family backgrounds of learners of public and independent schools. Respondents at the three independent schools reported somewhat more posi-

tive family experiences than the learners from the public school ( $M = 5.142$  and  $5.0061$ , respectively). The independent schools were Christian schools. Since most religions embrace an ethos of firm discipline, and since observation and teacher interviews confirmed that the independent schools had good discipline (in contrast to the public school), it can be argued that parents who enroll their children in these schools endorse similar values. However, more research is required on this issue.

In the past, the focus has been on school and classroom teaching only to improve science learning in South Africa. Consequently, poor results in science have often been addressed by providing more resources to schools (Reddy, 2005). The results of this study suggest that another route ought to be considered in addition to previous attempts at redress. Active parent involvement of a specific nature could enhance learners' motivation for and achievement in science learning. Schools can take the initiative in informing parents about ways that they can nurture scientific curiosity in children by creating a learning environment in the home for exploration and discovery. Schools should inform parents of the requirements of the science curriculum at the school and teachers should encourage parents to develop high expectations for their children's science learning, particularly among girls. Parents should be informed of the range of career options open to learners who have science as a subject and the utility benefits of such careers. These recommendations are of cardinal importance in South Africa.

### Conclusion and Recommendations

The pressing need to improve learners' performance in science in South African schools is a matter of national concern, which has been endorsed by government, educators on all levels of the education system as well as business and industry. In this regard, little attention has hitherto been given to the influence of family experiences in shaping motivation for and achievement in science learning. To address this gap, this study focused on family experiences and their relationship to motivation for science learning and science achievement.

The investigation is limited by the sample selection, which was non-representative. As such, the study was exploratory and should be followed by studies that use representative sampling techniques to increase external validity. Another limitation is the use of a self-report questionnaire, in particular with regard to the marks that the learners had obtained in science. Access to academic records would have yielded the actual science marks obtained by each learner respondent; however, such access could not be obtained since it would have compromised anonymity of the respondents. Future studies that include achievement as variable should use the actual achieve-

ments of the learners as indicated in school records if access were granted. This is a valuable contribution of this research for the improvement of future investigations that use academic achievement as variable. Studies of a qualitative nature are also required to gain a better understanding of the impact of family experiences on science learning.

In spite of the above-mentioned limitations, the research is valuable for various reasons. The results suggest that learners with more positive family experiences produced average to high results in science. Such learners are more likely to opt for science as a Grade 12 subject and pursue a career based on science. The study also seems to indicate that family experiences are gendered: boys reported more positive family experiences than did girls, with probable concomitant influences on science learning. This finding requires follow-up investigation to enhance insight on the impact of family experiences on boys and girls. Another important finding was that the racial grouping in this study did not have an effect on the kind of family experiences reported which suggests that the historical link between racial grouping and unequal social outcomes may be diminishing. The study also suggested positive outcomes if schools and families endorsed values that support learning. However, the most valuable result of this investigation is that it has focused the attention on the key role that the family can play to promote science learning.

### Note

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